THE MODEL ENGINEER

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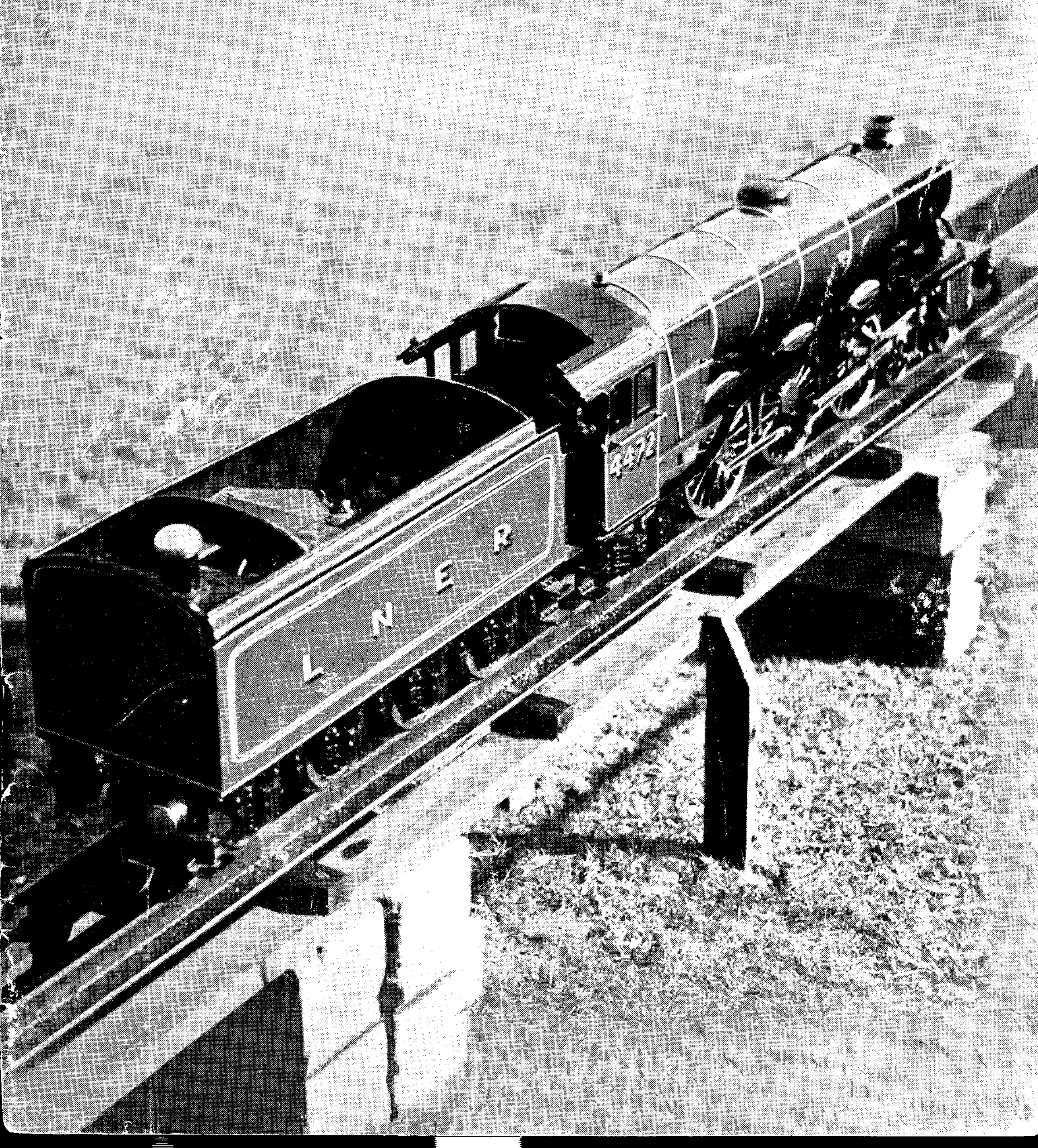


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

15TH DECEMBER, 1949 VOL. 101 NO. 2534

SMOKE RINGS

Our Cover Picture

● THIS WEEK'S cover is reproduced from a photograph taken by Mr. C. S. Francis, of High Wycombe, Bucks, who would seem to appreciate a very nice lighting effect on a miniature locomotive. We think that such a subject can often be the means of producing a pleasing picture by watching for a striking play of light. The engine is a $3\frac{1}{2}$-in. gauge, $\frac{3}{4}$-in. scale L.N.E.R. Pacific owned by Mr. G. Wakefield, also of High Wycombe.

A Notable First Exhibition

● MR. C. F. PALMER, hon. secretary of the Sutton Coldfield and North Birmingham Model Engineering Society has sent us a copy of the catalogue of the first exhibition recently held by the society. There were 220 models on view, more than 3,300 people visited the show, and the society gained 20 new members. From every point of view, the exhibition was thoroughly successful.

Once again, the wisdom of inviting the collaboration of neighbouring societies was fully demonstrated and resulted in a splendid display being put before the public. Kindred societies from Birmingham, Rednal, Coventry, Worcester, Tamworth, Leicester, Burton-on-Trent, Nuneaton and Hinckley sent models to add to the scope and interest of the show.

Every phase of our hobby was well represented, and we think that everybody concerned must be congratulated upon the organisation of what was undoubtedly an outstanding event. Visitors from all over the Midlands flocked to The Church House, Erdington, where the exhibition was held, with the result that the hall was crowded throughout the two-day duration.

From the New Forest

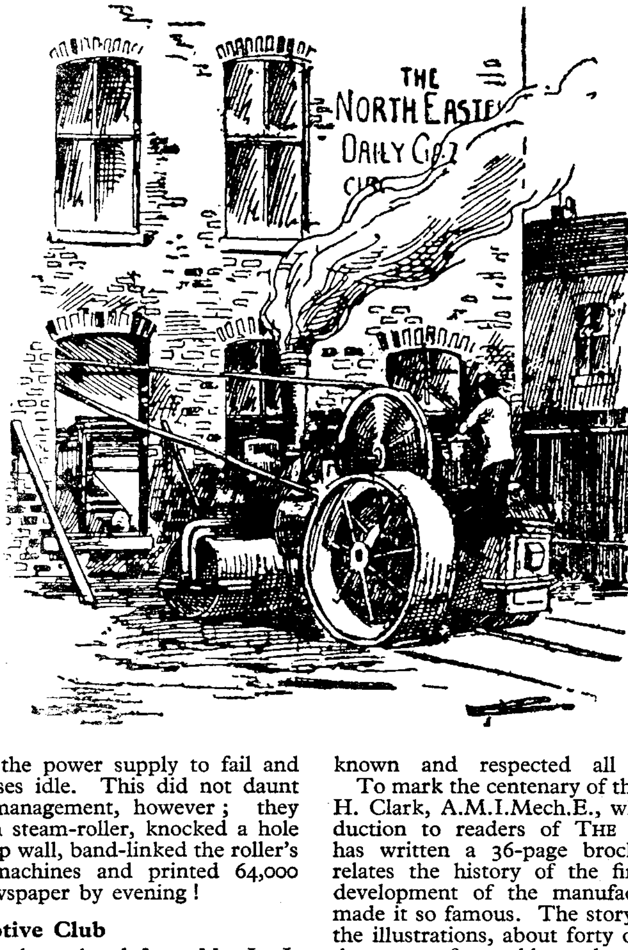
● MR. W. P. PITMAN and a few friends in the Totton area of Hampshire are discussing the possibility of forming a model engineering society in that district; they seem to think that it is long overdue. The society, if formed, will probably be known as the Totton and New Forest Model Engineering Society. We have been asked to publicise the idea and to request any interested readers to get into touch with Mr. Pitman, whose address is: "Sondrio," 20, Spicer's Hill, Totton, Hants. Incidentally, we are very interested to know that Mr. Pitman and his friend Mr. J. Butler have been subscribers to THE MODEL ENGINEER for forty-five and fifty years respectively.

Exhibition at Pinxton

● MR. FRED SMITH, hon secretary of the Pinxton Miners Welfare Model Engineering Society, informs us that the society are holding a Model Engineering, Arts and Handicrafts Exhibition at Pinxton, from December 14th to 17th, inclusive. The exhibition is open each day from 2 p.m. to 9 p.m., and a competition has been organised in connection with it. Valuable prizes are to be awarded, including a cup for the best exhibit (to be won outright). Further information can be obtained from Mr. Smith whose address is: Langton Bungalow, Pinxton, Notts.

Steamroller Prints a Newspaper

● WE HAVE frequently heard of traction engines being applied to tasks that would not be described as normal; but we do not recall having previously heard of a steamroller being pressed into service for printing a newspaper. We are indebted to the editor of the Middlesborough *Evening Gazette* for permission to reproduce the sketch on this page to illustrate an incident in the history of that newspaper. The incident occurred on November 15th, 1890, when an explosion in Middlesborough gas-works caused the power supply to fail and rendered the presses idle. This did not daunt the enterprising management, however; they borrowed a 15-ton steam-roller, knocked a hole in the printing-shop wall, band-linked the roller's flywheel to the machines and printed 64,000 copies of their newspaper by evening!



Another Locomotive Club

● A LETTER recently to hand from Mr. L. J. Markwick announces the formation of the East Sussex Locomotive Club. Although the membership is small, we understand that it is deliberately so because the activities are confined to *bona fide* small locomotive building. In this way, the active interest of members is kept up; in fact, attendance at meetings, so far, has been nearly 100 per cent.

Mr. Markwick states that the meetings are held in the workshop at his home, every Monday fortnight at 7.30 p.m., and every member is building a "live steam" locomotive of some sort, the smallest being a $2\frac{1}{2}$-in. gauge 2-8-0 and the largest a 5-in. 0-6-0 tank. At all meetings, several chassis are to be seen, and the evenings pass all too quickly, because of either work on some of the locomotives or interesting discussion so that *all* members take part.

It is hoped that, by next spring, about 200 ft. of track will be available for all gauges from $1\frac{1}{4}$ in. to 5 in., and a continuous track is to be constructed when circumstances will permit of it.

Mr. Markwick is hon. secretary, and his address is 577, Bexhill Road, St. Leonards-on-Sea.

Centenary of Savages Ltd.

● IN MOST articles and correspondence on the ever-interesting subjects of traction engines and road locomotives, the time-honoured name of Savages is almost certain to appear. It was in 1850 that Thomas Savage, then only 22 years old, set himself up in business as an agricultural and general engineer in King's Lynn, and from very small beginnings this business grew and prospered until the name of its founder, as well as his products, became known and respected all over the world.

To mark the centenary of the firm, Mr. Ronald H. Clark, A.M.I.Mech.E., who needs no introduction to readers of THE MODEL ENGINEER, has written a 36-page brochure in which he relates the history of the firm and traces the development of the manufactures which have made it so famous. The story is engrossing, but the illustrations, about forty of them, are a joy; they range from old woodcuts and photographs to drawings of more modern products, and illustrate a variety of objects extending from traction engines to a wood-turning lathe. Portable and semi-portable engines, steam winches, a Cornish boiler, galloping cockrels, centre engines, switchbacks, steam swings, road locomotives, steam tractors, organ engines, steam wagons and water-tube boilers, are all illustrated.

The brochure, which is very nicely produced, is for distribution among the firm's customers.

Acceptable Xmas Gifts

by Wm. Cleghorn

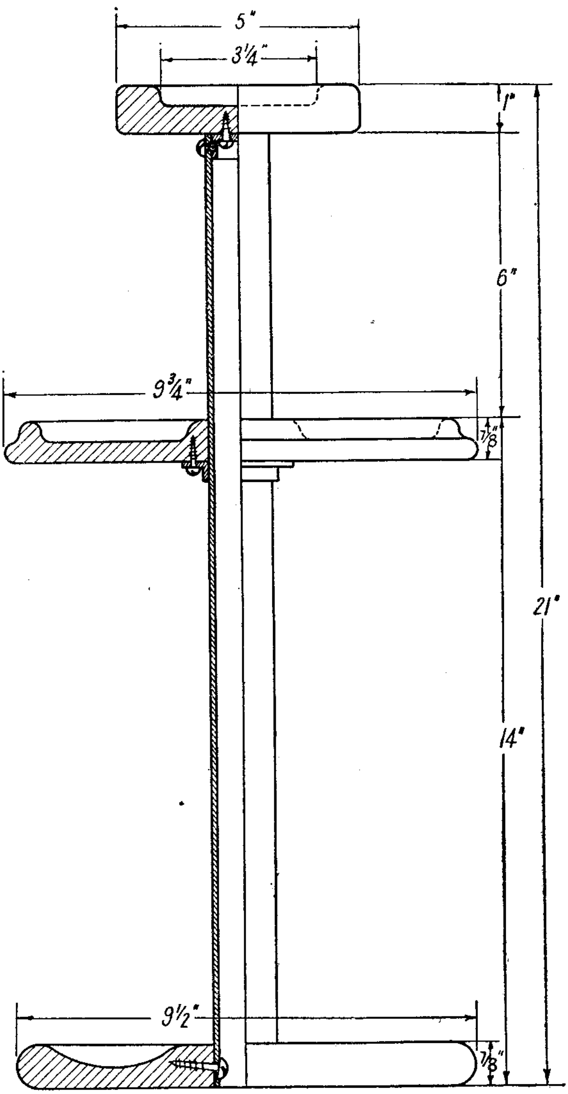
NOW that Xmas is drawing near, many heads will be well scratched, while pondering over the annual problem of, " what shall I give them ? " This question, to a model engineer who is the fortunate possessor of a lathe, should not present any insuperable difficulties.

The most common of all the useful articles made by the amateur are, one supposes, ash-trays of various types, the ordinary table ash-tray needs no description beyond the fact that there seems to be no limit to the differing materials from which it can be fashioned, being easily turned from hard wood or fibre, or beaten out from thin sheet brass, copper, aluminium or " what have you ? "

Pedestal ashtrays of the kind made by the writer and described below are quite simple to make, and one of them would be a really useful and appreciated Xmas gift.

In the ash-tray shown in the sketch, the top is made to hold an ordinary commercially-made ash-tray which can be readily lifted out for emptying and cleaning, or, if desired, the top could itself form the ash-tray by having its edge suitably notched to hold cigarettes. An addition which might be desired by some would be a match-box holder in the centre, but, in the writer's experience of these things, they are hardly ever used—and should a match be wanted the box will, more often than not, be found empty!

The top tray is attached to the pillar by means of a small brass cup (see sketch) which is screwed to the wooden disc with two or three small wood-screws and fastened to the tube by three small brass set-screws (No. 4 or 5 B.A.) which pass through clearance holes in the tube into tapped holes in the cup.



A pedestal ashtray, half in section

The centre table is useful for holding a cup of tea (or a glass and bottle according to taste), and is fastened as shown to a small flange which is fitted tightly on the tube and screwed or soldered on. The table itself is also bored out a nice tight fit on the pillar and thus makes a very rigid job, as distinct from some of the shop-made articles which, relying on glue, soon became slack and sloppy.

The base, also a good fit on the tube, is retained in its place, by three wood-screws put in from inside the tube into the wood; a large diameter tube makes this operation easier.

The biggest difficulty likely to be encountered is the obtaining of the necessary materials, but the wood used need not be oak or mahogany, any fairly hard wood is good enough, and when stained and polished will be passed by all but an expert.

The tubing for the pedestal may entail a visit to the local scrap-yard, an old brass tube from a Holden & Brooke steam heater being ideal for the purpose

and the length required comparatively short.

A long-bed lathe comes in very handy for this kind of work, for facing up the ends of the tube, etc., but the lack of such a lathe need not deter the would-be maker, as he can file up square the tube ends without one.

A Model Cannon

Another gift, which, if not so useful, is at least ornamental, is a model of an old-time ship's gun, or should one say cannon of the period early nineteenth century.

One of the best models of this kind, in the writer's opinion, was the one made by the late Mr. H. O. Clark of Norwich, a 24-pounder cannon on H.M.S. *Victory*, and which was ably described by Mr. Geo. Gentry in THE MODEL ENGINEER of September 1st, 1938, but unfortunately without giving details. However, the writer, having scaled it off from the photographs, made one, a much smaller copy of same. Mr. Clark's model is, as regular readers know, not only the gun alone, but also the necessary rigging, tools and even a part of the ship, and as such is a very fine model. The humble reader (meaning in experience) of these pages, would not be well advised to attempt a model of the grandeur of Mr. Clark's, but a model of the gun contained in it would be within the scope of most readers. Unless one is very meticulous ("L.B.S.C.'s" pet aversion), one need not be too particular over having all the details exact on a gun of this type, as not one person in ten thousand knows very much about them, and quite a lot of labour can be expended on details which only the maker will appreciate, and if the model is intended to be a gift, this work is wasted (one can see all the material for a real live debate in this statement).

Anyhow, as long as the gun is nicely polished and the carriage and fittings neatly made, the casual visitor on seeing same on the maker's (or friend's) hall-table or writing-desk will be sure to say, "What a nice model."

The two cheeks and the two stretchers of the gun are, in this model, made of $\frac{3}{8}$ in. red fibre and the piece or gun-barrel is of brass, as also are the wheels, ring-bolts and eye-bolts.

The gun-carriage relies on the thickness of the material used and the long bolts (or studs) which pass right through from end to end of the two stretchers. It will be seen that to ensure neatness, the ends of these stretchers must be filed dead square with the sides.

The trunnions, which, if a casting were used would be integral with the barrel, are in this case formed on a separate band, which is bored out a nice tight fit to the portion of the barrel made to receive it. If tight, no other fixing is necessary, but if there is any doubt about it, sweating on is advisable. The two trunnions can be turned to size before the band is fitted or after if the lathe is big enough to swing the barrel end on. The outer diameter of the trunnion-band should be left big and filed down when in its place, it can then be made to blend harmoniously and unnoticeably with the barrel. The writer's cannon was made with a separate breech-end screwed in a tight fit, but this was done only to use up a piece of brass which already had a hole through it.

The eye-bolts (two required), will be difficult for an amateur to make neatly (from the solid) and, therefore, it may be deemed better to build them up, by brazing or soldering a ring to the head of a set-screw.

The ring-bolts (three required) are merely small brass rings from curtain-runners fitted into the eyes of $\frac{1}{8}$-in. brass split-pins which are pushed into $\frac{1}{8}$-in. holes and opened out inside the carriage, the ends will not be too conspicuous if left very short.

The wheels, on round section axles (another departure from the real thing, as the old-time axles would be square) are retained by No. 6-B.A. set-screws and washers in tapped holes in the axle ends, correct practice would be to fit flat cotters or lynch-pins in slotted holes. The trunnion-caps should also be fastened down with cotters, but the fitting of a multitude of cotters would be a very laborious undertaking only justifiable should the gun be intended as a museum-piece and in that event all the other details would have to be correspondingly accurate.

Mr. Clark has achieved this standard of accuracy in his model, of which the one being described is only intended to be a slight imitation and not a replica.

The axle-caps are retained in place by long No. 6-B.A. studs or bolts, two of which at the front and pass right through the cheeks and serve to hold down the front end of each trunnion-cap.

The addition of the ring-bolts and eye-bolts makes the model look more realistic ; according to Mr. Gentry the rigging for this gun was :—

(1) Running out tackle consisting of a full-rove purchase (three-sheaved blocks) attached to ring-bolts each side of gun and thence to ring-bolts in the ship's side.

(2) Breeches-rope (for taking the recoil) secured to ring-bolts in ship's side and passing through the two eye-bolts and also through the eyelet knob on the gun.

(3) The train tackle, another full-rove purchase, was hooked in to the ring-bolt, in the rear stretcher of the carriage. This latter tackle, the writer assumes, was used for training the gun, with the assistance of sprags or hand-levers, and also, maybe, for making the gun fast when not in use ; a gun of this size would be a dangerous animal if allowed to go charging about the deck in rough weather.

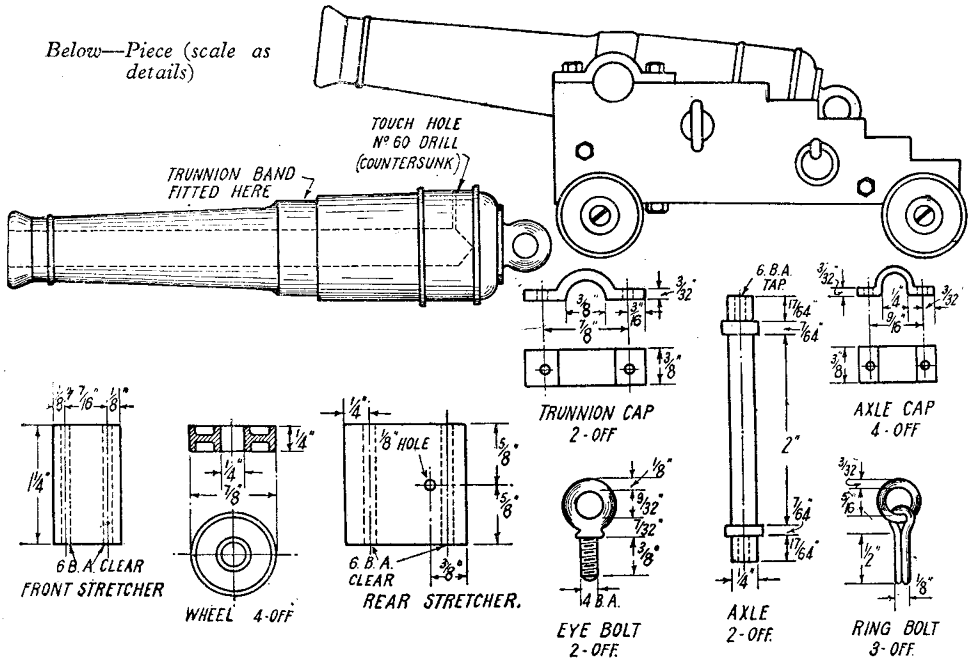
An omission from the model which may shock some of the purists is the wedge or quoin used for depression and elevation of the barrel, this, if made, would soon be lost, and if the trunnions are made a good fit so that the barrel will stay in any required position, a wedge will be superfluous although correct. To complete the model and make it capable of being fired, a very small touch-hole is drilled, about No. 60 drill would be somewhere near the correct size.

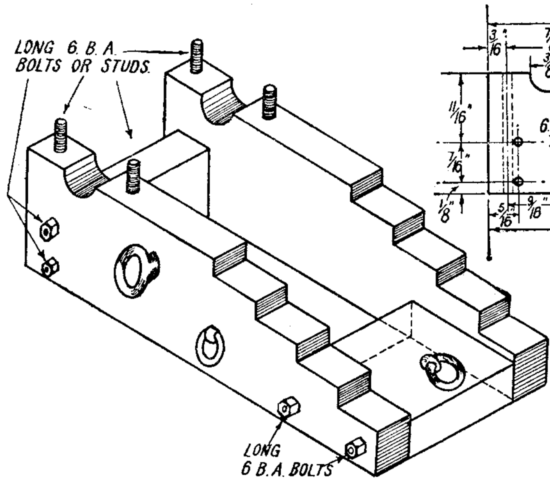
An excellent combination of materials for this model, if obtainable, is duralumin and ebonite (or black fibre), this when polished is indistinguished from silver and ebony.

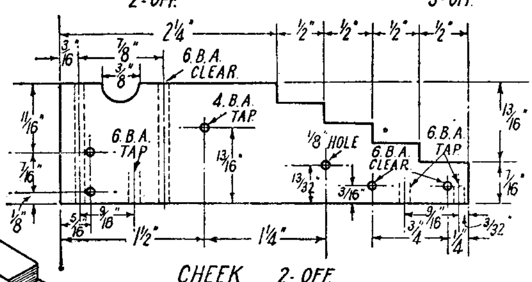
A Poker

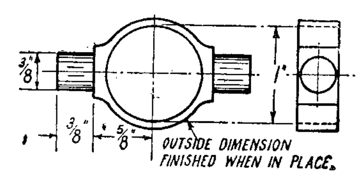
To turn from ballistics and the romance of

Below—Piece (scale as details)









The carriage assembled, showing arrangement of eye bolts, ring bolts and stretchers

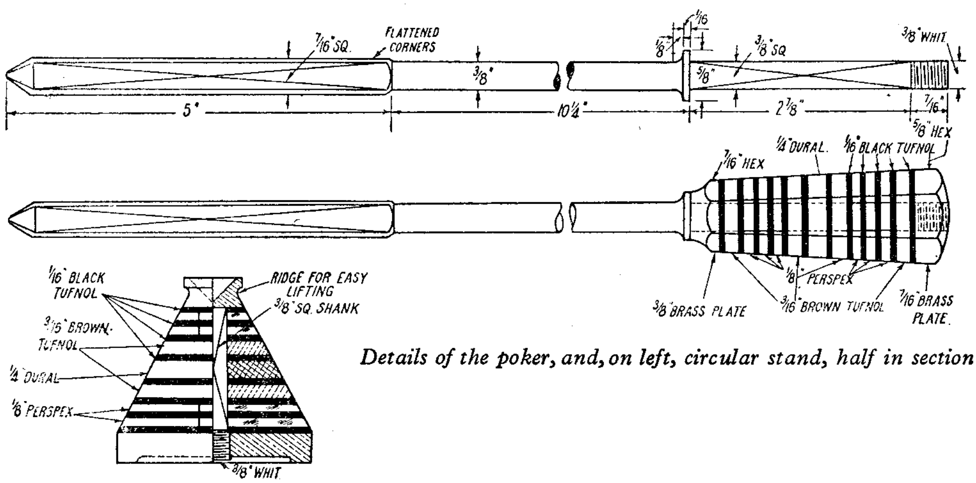
sea-fighting to a more prosaic, but also a more homely subject, many years ago, when the writer was serving his apprenticeship, a favourite gift to make was a poker ; in those days they were made by screwing a long thread (about 3 in) on the end of a $\frac{3}{8}$-in. steel-rod, making a lot of washers of differing materials such as red fibre, copper, brass and aluminium, these washers were put on the screwed rod, being tightened up between two $\frac{3}{8}$-in. nuts, and also in such an order as to form a simple design. This assembly was next put in the lathe and turned down to the required shape, and that was the handle completed, the other end was simply a piece of $\frac{1}{2}$-in. square mild-steel, drilled and tapped $\frac{3}{8}$ in. at one end and screwed on to the $\frac{3}{8}$-in. steel already mentioned.

Since those days many new materials are available including duralumin, and transparent plastics such as "Perspex," a very valuable plastic which is greatly used for aeroplane windscreens, etc., for the reason that it is strong and does not shatter like glass. A few scraps of this material in either $\frac{1}{4}$ in. or $\frac{1}{8}$ in. thickness will

make a handsome poker-handle over which all the female members of the household will go into raptures.

The procedure is to cut the material into a sufficient number of washers of a size to suit the proposed design (worked out beforehand) and with a $\frac{3}{8}$-in. hole through the centre of each, mount them on the screwed end of a $\frac{3}{8}$-in steel. rod. The nuts are then tightened so that all the washers are firmly held, the *tout ensemble* is then put in the lathe and turned to shape, necessary, as the lathe will jar horribly without it, a keen tool should be used, and do not attempt to take too light a cut as, in the writer's experience, this also causes a certain amount of jarring; a cut should be put on which cuts without just scraping along.

The square end can be filed on or cut with the lathe by the old-fashioned method of bolting a small tool-holder block to the faceplate, the work, fastened to the top-slide, is then fed slowly past the revolving tool and a good flat surface



Details of the poker, and, on left, circular stand, half in section

being finally polished with emery cloth and metal polish, which latter brings up the Perspex until it has the brilliance and transparency of crystal. The shape preferred by the writer is a taper hexagon made by turning the handle to a taper, then, with the aid of the back-gear teeth, dividing the circumference into six parts and filing to the lines. For those readers who may not be familiar with this method it should be stated that a suitable detent is made to engage with one tooth-space of the back-gear wheel, and as these wheels very often have sixty teeth, it will be seen that moving the wheel ten teeth moves the job one-sixth of a turn, and if the lathe tool be set to just touch the work, then by feeding the tool across, a line will be scribed on the work; this operation performed six times gives the requisite markings for filing a hexagon.

The business end of the poker may be a separate piece of $\frac{1}{2}$-in. mild-steel drilled, tapped and screwed on as before mentioned, but a much neater way is to make the whole thing in one piece. The writer, having a long-bed lathe, prefers to make these pokers all in one from a piece of $\frac{5}{8}$-in. B.D.M.S. which is turned down to give a $\frac{7}{16}$-in. square (with flattened corners) at one end, then to $\frac{3}{8}$-in round in the centre portion, and the handle end has a $\frac{5}{8}$-in. collar left on it, and is then turned down again to give a $\frac{3}{8}$-in. square; this square will be explained shortly.

When turning long, slender articles such as this, a travelling steady rest will be found very is obtained which only needs a little cleaning-up with the file.

An alternative way of making the poker would be to use a length of $\frac{7}{16}$-in. square section mild-steel, and this gives the required squares already made, the only difficulty about this method is the fixing of a collar for the handle to abut against, the collar could be either pinned or brazed on, or both.

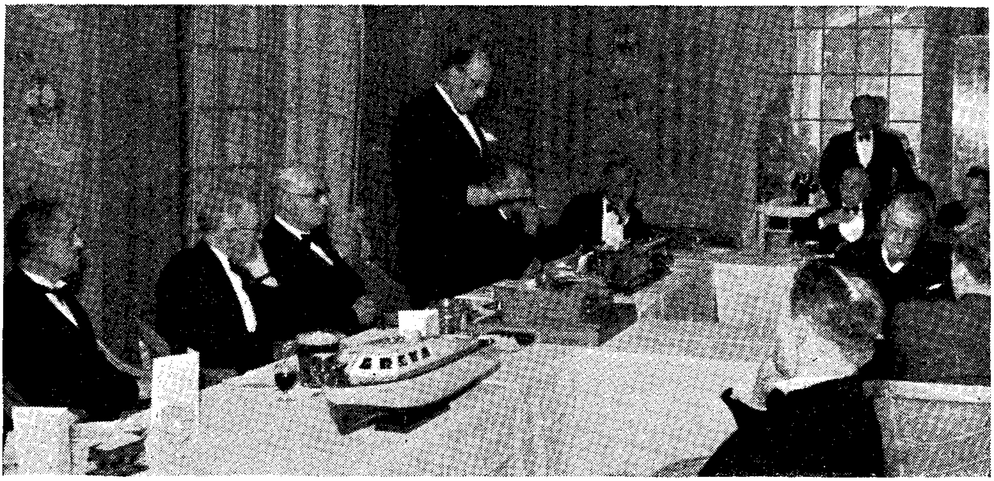
The idea of having a square at the handle end is that nearly all plastics, fibres, etc., shrink with age, and nothing spoils a nice handle more than to find that, after a few weeks standing by the fire-side, all the sections of which the handle is made are loose and will turn in any direction. This condition is very much worse when the handle is of hexagonal or octagonal shape, as the sections will then have very sharp corners and edges, quite capable of injuring the fingers. Fitting the washers on a square, although it entails a deal of work, obviates any possible chance of them becoming slack and moving about. There is another way of locking the washers, i.e., by drilling a hole lengthwise through the washers and driving in a tight-fitting pin passing through all the pieces, the end of the pin then being expanded by caulking.

The poker completed, a stand will be required, this can be made on the same principle using laminations which should, preferably, match in design the handle of the poker.

The stand has for its foundation a piece of

(*Continued on page* 753)

Fiftieth Anniversary of Bassett-Lowke



Lord Brabazon of Tara speaking at the Bassett-Lowke Jubilee Dinner

MESSRS. BASSETT-LOWKE, who, as we have already noted, have been celebrating the fiftieth anniversary of the firm's foundation, brought the celebrations to a fitting conclusion by giving a dinner at the Savoy Hotel, London. The guest of honour was the Rt. Hon. Lord Brabazon of Tara, P.C., M.C., who proposed the toast of Mr. W. J. Bassett-Lowke and the firm. Mr. George Holland, the well-known lecturer and critic, gave a most excellent address on "The Craft of Model Making." Mr. H. M. Sell, in a characteristically lively speech, proposed the toast of the visitors, to which Mr. George Dow responded. Altogether, it was a most enjoyable function, an appropriate climax to the occasion.

Incidentally, Messrs. Bassett-Lowke have issued a special and well-illustrated booklet in connection with their jubilee ; it tells the whole story of remarkable progress from humble beginnings to the present day, when the name enjoys the distinction of being a household word in almost every corner of the earth.

For the Bookshelf

Buffers End, by Emett, of *Punch*. (London : Faber & Faber Ltd.) Size 7 in. by 10 in. Price 12s. 6d. net.

This is a further collection of upwards of forty fantastic drawings and cartoons from the originals by the one and only Emett. Many of them have a railway interest, according to their author's grotesque interpretation of such matters ; but others deal with other features of this mechanical age in a spirit of mildly satirical fun. It is a book to delight anybody who possesses a sense of humour, not to mention Emett's many devoted admirers.

Painting and Lining Models. By R. C. Rogers. (London : Percival Marshall & Co. Ltd.) Price 3s.

As all model engineers are fully aware, the correct finish of a model is an important adjunct to its beauty and realism, and calls for great skill in its execution. Many otherwise excellent models are marred by the careless or unskilled application of paint or enamel, and instructions on how to use these media to best advantage will be welcomed by many practical model builders. While the technique of painting and decorating models does not differ in general principles from that employed in full-size practice, it presents its individual problems, and the author of this book has set out to deal with these in a practical manner. The nature of paints, varnishes and pigments is discussed, with instruction on their properties, and application to specific purposes. Methods of application, by brushing, spraying and dipping, also stoving, and treatment of surfaces, both before and after preliminary coatings, are then dealt with. In the final chapter, the difficult operations of lining and lettering, the use of transfers, and finishing varnishes are explained. This book will definitely promote the aim in which all readers of THE MODEL ENGINEER are interested—namely, the production of better and more realistic models.

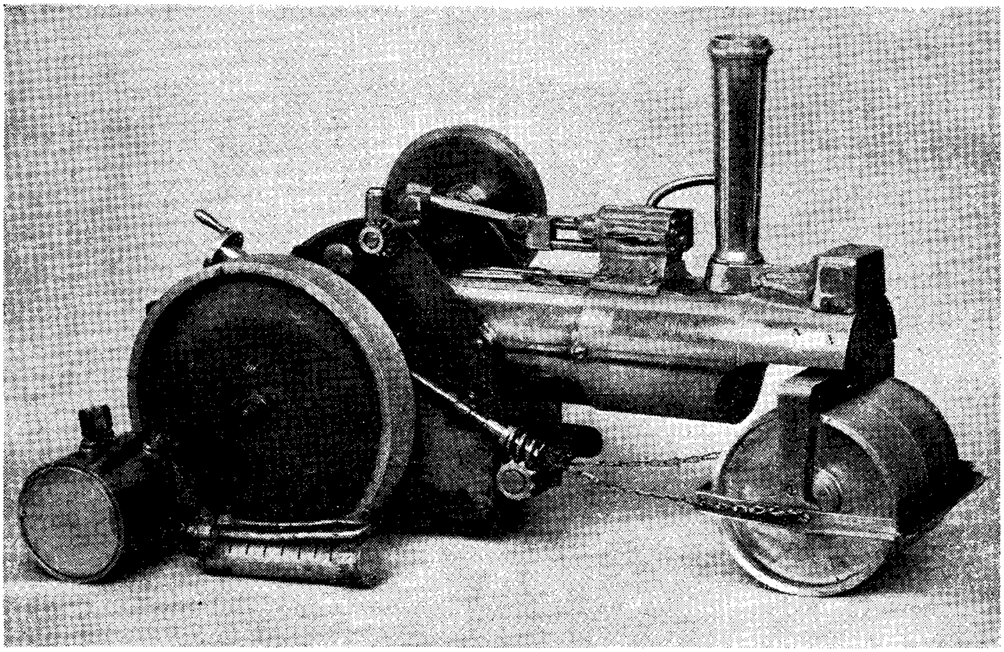
The Story of a "Quickie"

by N. A. Canty

THE story really starts about the middle of December, a year or so ago, when (in a very weak moment), I promised my small son he should have a steam roller for Christmas. A model, of course! His immediate concern was that it should have a fire in it, and rashly, I promised it should. That did it! Everyone he knew (and lots he didn't know), were informed of his promised present, and of how (in his four-year-old "lingo") it would have a "really" fire in it to make it go!

A week before Christmas, I suddenly realised how awfully short time was getting. On informing a model engineering friend of my plight, he promptly set the wheels a-turning by handing me a piece of 16-gauge, 3-in. diameter copper tubing. A real turn out of my scrap box produced odds and ends of brass, duralumin, etc., a few odd gears, and a handy chunk of phosphor-bronze, and I was all set for action!

The first items to be made were the patterns for the rear wheels, and the halves of the front roller. These were cast in aluminium alloy. Then followed the patterns for the front roller frame, and the cylinder saddle mounting. The pattern for the chimney mounting, was cut from a piece of balsa wood, one evening after supper. The "tools" used—a razor blade!



A model steam roller made "on the quick"

I should mention that I have a friend who runs a small foundry, so there was no delay over castings.

The cylinder was not cast, but was carved from the piece of phosphor-bronze. This item took the most time. The stroke is 1 in. and a boring error resulted in the previously estimated bore of $\frac{9}{16}$ in. being 19/32 in. The cylinder is lagged with asbestos held in place with a copper lagging band. Correct type of eccentric was fitted, the strap being made of bronze. Lack of time (time, tide and Christmas Day, I found, wait for no man!) compelled me to make the connecting-rod in one piece, from brass. The flywheel, eccentric and gears, are held by Allen grub-screws.

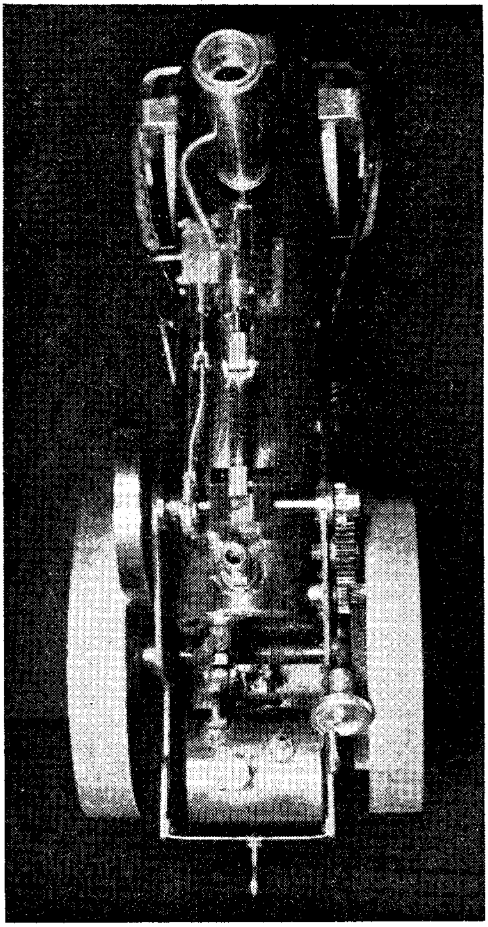
The crankshaft was built up ready for brazing, and both the shaft and the crankpin are $\frac{3}{8}$ in. diameter.

Next came the boiler. It is 7 in. long, and is an ordinary pot boiler, with the addition of four $\frac{1}{4}$-in. water-tubes to "help things along." Bosses for the safety-valve-cum-filler, and the regulator-valve were turned from brass bar, as were also, 8 blind bosses, tapped 2 B.A. After these were fitted, the boiler and crankshaft were handed to my friend, who made a very good job of brazing both.

The front portion of the boiler was made from a piece of $3\frac{1}{8}$ in. diameter by $\frac{1}{4}$ in. thick brass tube. One end was bored to receive the boiler proper, about 1 in. deep, and the two parts are secured in position with two 2-B.A. screws, which screw into two of the blind bushes in the boiler. These can be clearly seen in the photograph.

The cab sides are made from $\frac{1}{8}$ in. mild-steel plate, and are extended upwards to take the crankshaft bearings. The sides and the bottom are of 16-gauge brass. Odd materials, I know, but it was all that was to be had that particular Sunday afternoon, and the $\frac{1}{8}$-in. plate was "gleaned" from a nearby scrap heap! The cab is riveted with $\frac{1}{8}$-in. rivets at half inch pitch. All bearings are plain bronze bushes, held in position with two $\frac{1}{8}$-in. screws in each. The towing hook was originally a 2-B.A. bolt.

The arrangement of the gears can be seen in the photographs. The final drive is by gears taken from an old hand-grinder, and give a reduction of 13 to 1.



The "Quickie" from above

The worm and worm wheel for the steering, was salvaged from a crashed plane, and although I have had them by me for some years now, I have always imagined them just where they are now!

I was fortunate enough to come across a 4 in. diameter piece of steel, just asking to be a flywheel, so there it is!

The small regulator-valve was made some twenty years ago by my model engineer friend, (yes, these friends certainly stick!) and given to me as a boy. It will no longer regulate the flow of suds from my suds tin on the lathe!

The chimney is turned from dural bar and is a press fit in the mounting. The hand wheel, for steering, is also dural, and the steering chain—for want of something better—is ordinary picture chain.

The arrangement of the steam and exhaust pipes is crude, but time was very short. As it was, the model was completed only four hours before Santa Claus was due to deliver it!

The overall length is 19 in., height to top of chimney $11\frac{1}{2}$ in. and width over rear wheels 7 in. The front roller is 4 in. diameter, and 4 in. wide, and the rear wheels are $6\frac{7}{8}$ in. diameter. In all, I was five days, plus the already mentioned spell of overtime in making this "quickie," including the time for drawings (rough sketches) and the patterns.

Acceptable Xmas Gifts

(*Continued from page* 750)

$\frac{3}{8}$-in. brass or mild-steel plate into which is screwed the reduced end of a $\frac{1}{2}$-in. brass or steel bolt, the body of the bolt is squared for the reason given above, and the head of the bolt has a large "dimple" or countersink in which the poker stands. The plate and bolt, between them, hold the washers as before, and are turned to shape after assembly.

A further elaboration for the ambitious constructor would be to combine the pedestal ash-tray minus its centre-table with a set of fire-irons, i.e., poker, tongs, shovel, and brush, all with handles to match, and hung from hooks screwed into the edge of the top tray.

Hoping that these few scattered and very random remarks will be of value to readers, although they do not contain very much in the way of model engineering.

*A Domestic Refrigerator

by L. C. Sherrell

THE big-end strap complete with race can now be put central on the journal and the short end jammed on its taper. Mount the complete assembly between centres and set to run true, jack it right home tight to its shoulder, spinning it periodically to check for truth. Before any further work is carried out the ball-race is a smooth surface for the rubber ring, which, as previously explained, prevents gas escaping along the crankshaft. The ¼-in. keyway can be milled on the cross-slide, care being taken not to bruise the shaft. Fit a $\frac{1}{16}$-in. split-pin to the castle nut and we are now ready to assemble the compressor.

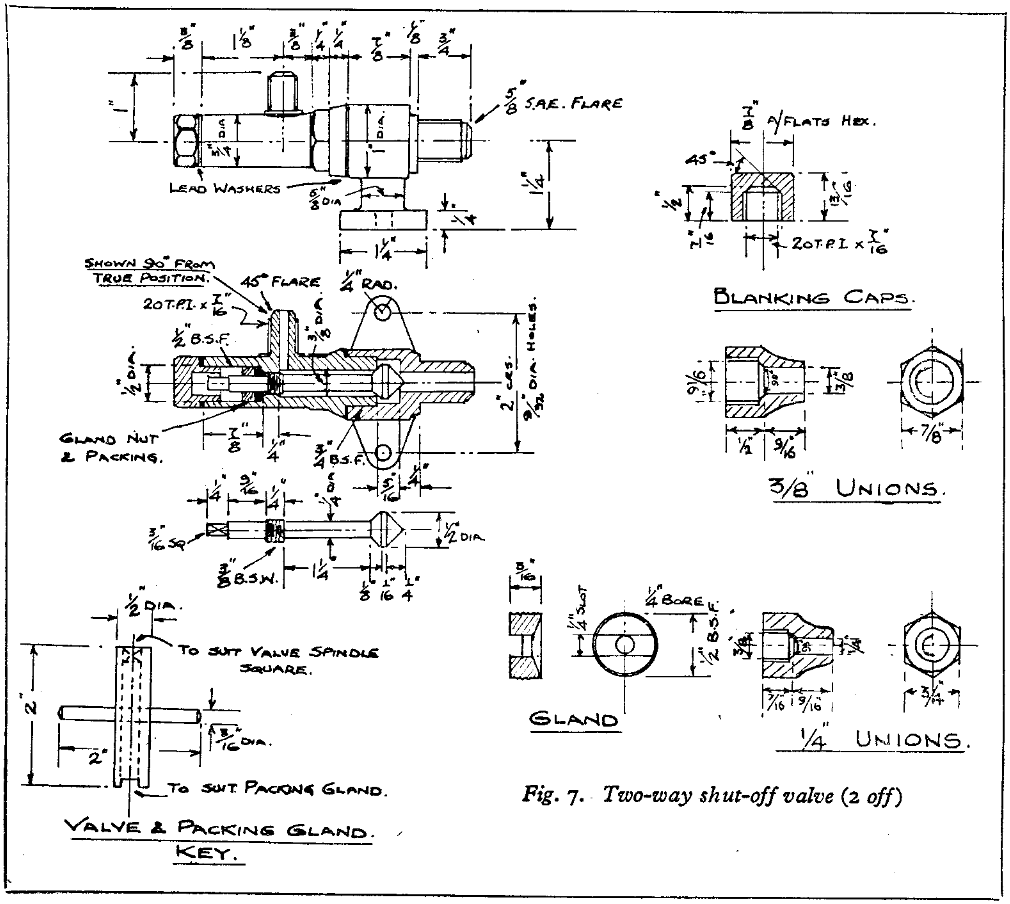


Fig. 7. Two-way shut-off valve (2 off)

completely covered with insulating tape to prevent swarf from getting to it and at the same time stop the strap from thrashing about. This done, it can be turned between centres to a diameter of 0.625 in. where the races are positioned. The remainder is polished with emery-cloth which will remove half-a-thou. to allow the race to be pushed on easily and at the same time provide

Since the compressor has been built, it has been found desirable to substitute a roller-race for the ball-race originally fitted to the big-end bearing. This race (Hoffman R.L.S.7) is exactly the same size as the L.S.7 ball-race and interchangeable with it. This alteration was called for by the fact that during the warm weather last summer when room temperature rose to 86 deg. F., the pressure in the compressor increased so much as to overload the ball-race and cause harsh running. Apart from this no

**Continued from page 726, " M.E.," December 8, 1949.*

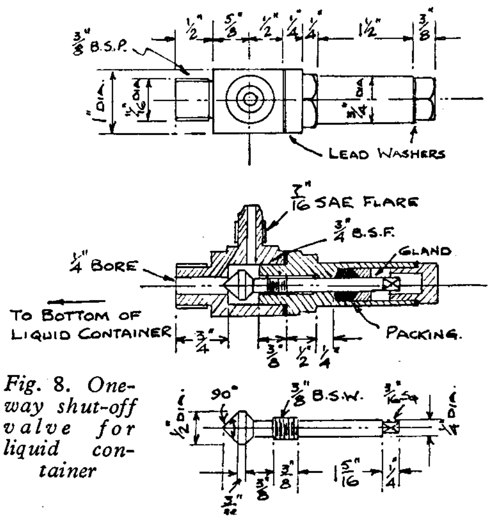


Fig. 8. One-way shut-off valve for liquid container

mechanical trouble whatever has been encountered and the refrigerator has given complete satisfaction.

Assembling Compressor

Any scale, etc., in the crankcase must be removed before assembling. The first part to go in will be the crankshaft, and if put on bottom stroke it will just go through the 3-in. hole and allow the splasher strig to be screwed in. Put the thrust-race in position and bolt on the end-plate with ½-in. × ¼-in. set-screws, using thin compressed fibre for joint rings ; the race for the other side is put in the seal housing and bolted on likewise. The big-end strap should now be dead in the centre of the crankcase. Screw the connecting-rod complete with piston and valve, etc., down tight to its shoulder. The cylinder, valve plate, and cylinder-head is now fitted, not forgetting the joint rings.

The length of the distance collar can now be determined, made and fitted. Put a smear of pure vaseline (the stuff they use for babies) on the crankshaft and slide on the rubber ring,

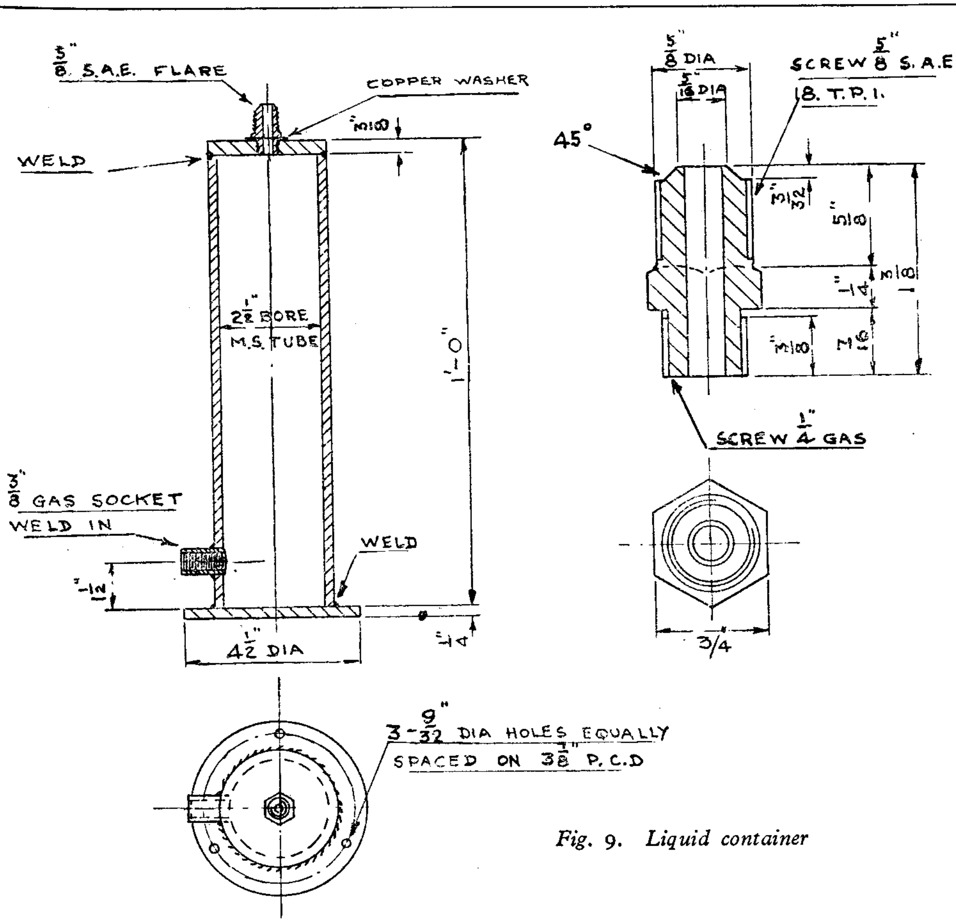


Fig. 9. Liquid container

followed by the hardened steel cap and seal bellows with lead gasket, care being taken to tighten the plate up evenly.

Shut-off Valves. Figs. 7 and 8.

Before the compressor is tested these valves may as well be made and fitted. Two to Fig. 7 and one to Fig. 8 will be required. They are made in brass, using "Easyflo" to fix the $\frac{7}{16}$ in. flares

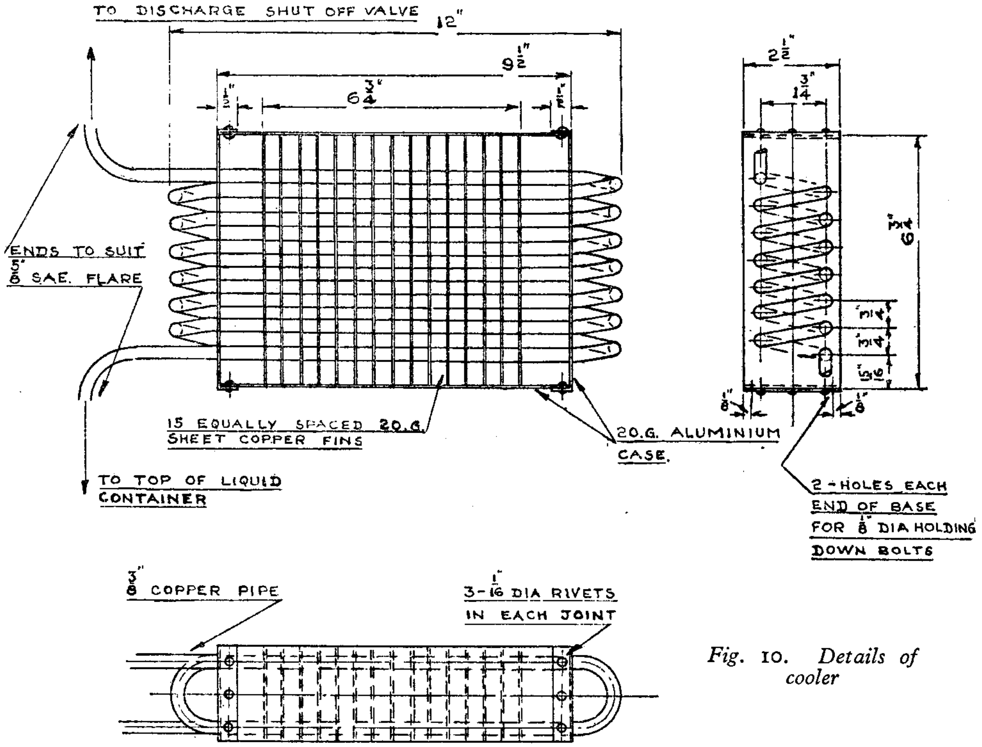


Fig. 10. *Details of cooler*

and flanges. These flares, by the way, are the recognised standard fitting for all refrigerators, so it will simplify matters for the constructor if they are made interchangeable. The expansion-valve can be used as a male gauge.

The glands are packed with asbestos string. I show lead washers on the drawing, but on second thoughts annealed copper will be more reliable.

Testing the Compressor

Fit the Schrader valve to the suction shut-off valve and pump up to a pressure of not less than 100 lb. per sq. in., submerge completely in water and turn crankshaft round very slowly to make sure the seal is completely pressure-tight. I trust readers won't think all this testing is being taken a little too far; I would hasten to assure them that the slightest leak will be sufficient to cause the unit to be put out of commission in less than a fortnight, and, furthermore, a small leak is very difficult to detect and remedy when finally assembled. Thus Enemy No. 1 is leakage.

Enemy No. 2 is moisture, which by filling the compressor with air we have in plenty, and as one small bead of water is all that is required to freeze up and block the passageway of the expansion-valve, steps must be taken to see this cannot occur.

An easy way to do this is to remove the seal assembly and bake the compressor in the gas oven for 1½ to 2 hours with the regulator as low as possible. On removing, replace the seal, etc., while still warm plus a liberal helping of vaseline in the seal pocket. It can now be charged with oil, and stood aside till required, both valves, of course, being closed.

Either of these two oils are suitable for methyl chloride: Gargoyle Arctic "C" Heavy or Shell Mex A.C.II. Half fill the crankcase; this will allow for a certain amount that is continuously circulating through the system.

Liquid Container. Fig. 9.

If 2½-in. tube is not available, 3 in. or 3½ in. can be used, making it a trifle shorter to keep the capacity more or less the same. When finished, it should be capable of standing 200 lb. pressure, as a hot summer's day can send the pressure well over the 100 lb. mark. Dry and seal as per compressor.

The Cooler. Fig. 10.

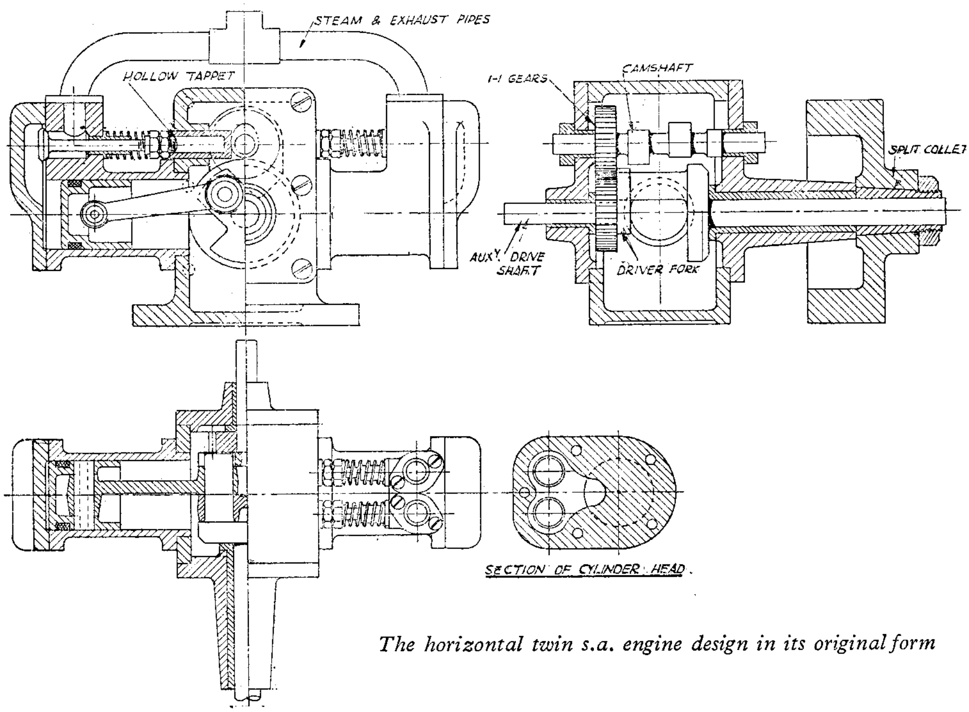
This is made up of ⅜ in. o.d. 20-gauge copper tube. Six pieces *A* (Fig. 10A), 6¼ in. long; five pieces *B* (Fig. 10A) 1 ft. 7¼ in. long; two pieces *C* (Fig. 10A), 1 ft. 9¾ in. long are required.

(*Continued on page* 764)

*UTILITY STEAM ENGINES

by Edgar T. Westbury

THIS series of articles has already exceeded, both in length and scope, its originally allotted span, and it would seem that the subject is by no means exhausted yet. At the outset, the intention was merely to give some practical assistance to readers who were interested in producing a steam engine capable of useful work in the propulsion of a power model (as distinct from making a "prototype" model steam engine), and to fill some of the gaps in the general knowledge about steam engines which appeared to exist, according to many queries received from readers. But as soon as the first articles in the series appeared, I was asked by readers to pursue the subject still further, and in more minute detail; many questions were asked on aspects of steam engine design and construction which seemed to go far beyond the "utility" sphere; and in particular, many requests—indeed, almost amounting to demands—were made for new steam engine designs. After several months during which I have done my best to cope with these requirements, I find that readers are still, like Oliver Twist, asking for more!



The horizontal twin s.a. engine design in its original form

A few readers have criticised these articles on the grounds that the information given is not sufficiently exact; they would, presumably, like to see valve timing specified to the last minute of a degree, and the amount of heating surface in a boiler worked out to six places of decimals. Some of them infer that if I am not competent to supply these figures (which, I freely confess, is actually the case), I cannot claim to be qualified to write these articles at all, and should give up the attempt. But most of my readers will realise that model engineering is a very inexact science, and to obtain really accurate data even on one small detail of design would be a very long and painstaking task. In full-size engineering practice, or at least some branches of it, there is a good deal of accurate data and formulae available, but even so, the application of this information to any new problem is not so dead simple as is commonly imagined, and experimental work can never be entirely eliminated; this applies not only to new or advanced projects, but also to those which are often regarded as fully established.

I have never scoffed at attempts to solve model engineering problems by pure theory, or mathematical formulae; on the other hand, I have often used it myself, or taken advantage of assistance

*Continued from page 703, "M.E.," December 1, 1949.

rendered by friends more highly qualified in this sphere, to improve details of design and simplify experimental work. Good theory, properly applied, represents good practice, and mathematics is an exact science; given the correct figures to start with, and the correct formula on which to work, one can be 100 per cent. sure of getting exactly the right answer. But the snag is that neither the formula nor the starting-off figures can be obtained without a good deal of practical spade-work; and without them, we are but wanderers in a vast wilderness. Frankly, I am dubious about the possibility of producing successful engines with purely academical tools—but I am always willing to be convinced!

Assuming, however, that one *could* produce a design in this way, with every part and function so nicely calculated that it would immediately produce optimum performance for its intended purpose—can we be sure that this would best serve the cause of model engineering, or give satisfaction to the model engineer? I must confess that the idea of an engine so perfectly planned that it has no unknown or unpredictable qualities fills me with horror. It is as soulless as the ideal Welfare State, the Perfect Woman, or the Theory of Predestination! There may be those among us to whom the idea of a super-planned model, "from raw material to record-breaker" or "from drawing-board to Championship cup," may appeal, but I think most readers will share my view that the exercise of one's own intelligence and individuality in the quest for perfection is a necessary factor, and one of the greatest attractions, in model engineering.

A Horizontal Twin Engine

This engine is based on, but not exactly copied from, an engine which I built from the solid some years ago, and considerably mutilated in the cause of experimental work.

The horizontally-opposed or "flat-twin" engine has always been the pet of designers and theorists, though too often the nightmare of the practical constructor. Whether built as an i.c. engine or a steam engine, it offers some very obvious advantages—and even more not-so-obvious snags and disadvantages. Incidentally, the term "horizontally-opposed" is somewhat ambiguous, as it may be taken to refer merely to the disposition of the cylinders, as in this case, or the dynamic balancing of reciprocating forces by the use of a two-throw crankshaft, causing the pistons to move always in opposite directions, as in the "Craftsman Twin" two-stroke.

In a steam engine, dynamic balance would be desirable, but less so than the equal spacing of torque impulses, obtained by working both pistons from the same crank throw; at least in small engines, where unbalanced forces are light. The twin single-acting engine, arranged as shown, may be regarded as mechanically equivalent to a single-cylinder double-acting engine in respect of frequency and spacing of power impulses, and the effect of unbalanced forces. It is inferior to the side-by-side single-acting twin, in respect of primary balance, but is free from the rocking couple along the shaft, which is sometimes more troublesome than primary unbalance, in actual practice.

The long branched steam and exhaust pipes necessary on a horizontal twin engine of this type may be objected to on the grounds of appearance, and also the risk of condensation, but are probably a lesser evil than the long induction pipe of a four-stroke flat twin i.c. engine, which often causes carburation trouble. No doubt one of the most solid practical assets of this form of engine, whether steam or i.c., is its low centre of gravity, and the small amount of head-room required for its accommodation, which enables it to be housed completely below decks, even in a boat of shallow draught.

Many readers will remember the horizontal steam engine designed some years before the war by the late Mr. S. E. Blakeney, and used in conjunction with his water-tube boiler and atomising burner, which have already been referred to in these articles. I saw a good deal of the development of this plant, and I came to the conclusion that while the engine was very successful and easy to construct, its success was largely dependent on the efficiency of the boiler and burner, which ensured that plenty of steam was always available. The particular form of porting used with the piston valves of this engine is highly satisfactory for moderate performance, but suffers from the disadvantage that efficient port timing can only be obtained with a restricted size of port, which is liable to cause wiredrawing at high speed. Opening out the ports to avoid this causes waste of steam, by uneconomical valve timing, and these conditions cannot be avoided in any form of slide or piston valve engine *where the control ports consist of single round holes.* It would, of course, be possible to redesign the valve-gear to use annular or slotted control ports, but at the expense of simple construction, which was one of the most attractive features of this little engine.

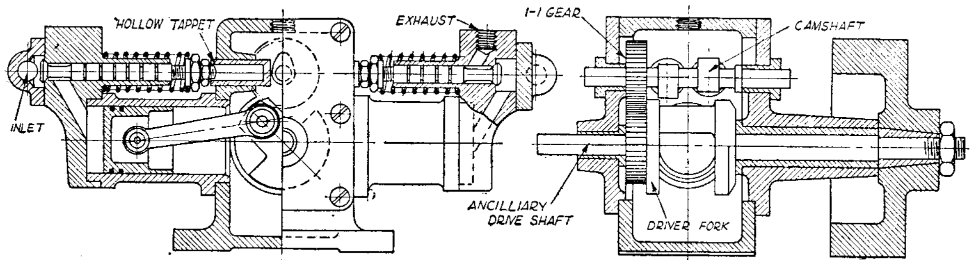
This is not a criticism of the Blakeney engine in respect of its general utility; taken in conjunction with the rest of the plant, it was a very compact and efficient power unit, quite equal to the work for which it was primarily intended. Only when economical working at the highest power output is called for would improvement be desirable, but as I know that some constructors attempted to use the engine with less efficient steam generators, or to adapt it for racing purposes, without very great success, these remarks, I hope, will not be considered out of place.

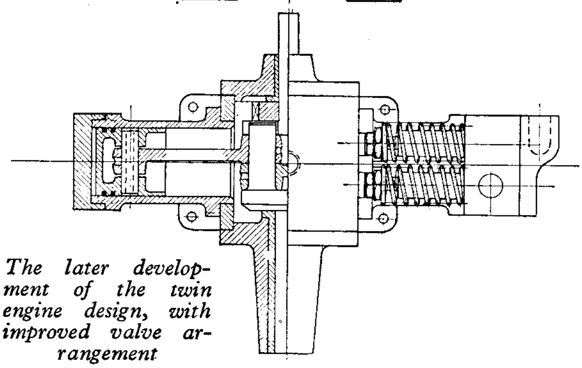
After some experiences with a Blakeney engine, I decided to build an engine of generally similar type, but to equip it with poppet valves instead of piston valves. The arrangement of these called for some careful thinking, as I had decided to use the valves both for steam admission and exhaust, instead of working on the uniflow system, as in the other poppet-valve engines which I have described. It would, however, be quite practicable to use this system if preferred, and some readers may wish to adapt the design in this way.

For simplicity of operation, the valves might have been placed at the sides of the cylinders, and operated from cams on the two ends of the crankshaft; but for the sake of compactness, and complete enclosure of cams and tappets, I decided to use a separate camshaft, placed

above the crankshaft, and geared to it by spur gears of even ratio. It will, of course, be apparent that only one pair of cams is necessary to operate both sets of steam and exhaust valves, as the cams act alternately on the tappets on either side of the crankcase. The cams are of harmonic form, that for the exhaust having an opening period of 180 deg., and the steam admission cam having a much shorter period, both this

In the original version of the design, the steam and exhaust valves were exactly alike and opened into a chamber in the cylinder head, the valve housings and guides being integral with the cylinder barrel. This made for simplicity in construction, and worked very well at relatively low speeds and pressures ; but it had the disadvantage that steam was applied under the head of the admission valve, and the valve stem





The later development of the twin engine design, with improved valve arrangement

was under full steam pressure, tending to cause leakage, especially if fitting was initially imperfect, or impaired by wear. Moreover, steam pressure tended to open the valve, which thus became extremely liable to "float" at high speed, and thereby waste steam, unless an excessively strong valve spring was fitted.

The head was therefore altered so that the steam was admitted from the outside of the admission valve, the stem of which was isolated from steam pressure, except during the actual period of admission. Steam pressure also acted against the opening motion of the valve, thereby reinforcing the strength of the spring ; and increase of boiler pressure tended to prevent valve float instead of encouraging it. These conditions, of course, already applied in the case of the exhaust valve, which did not have to be altered in essential principle, though both valves were improved in detail, and the stems enlarged to facilitate fitting. The valve housings were formed in the cylinder-head block, and drilled ways used to communicate between the valve ports and the cylinder ; these holes can be drilled large enough to avoid any suspicion of wiredrawing at any engine speed likely to be usefully employed.

factor, and the relative positions of the cams, being subject to modification as indicated by experiment.

An overhung crankshaft was used, housed in a long bearing at one end of the crankcase, and the camshaft gearing was driven by a fork or "follower crank" at the other end. The bearings for main and ancilliary shafts, also the camshafts, were plain bushes in all cases, carried in endplates registered by spigots concentric with the main shaft centre, and attached to the front and back of the main crankcase casting. In the fabricated version of the design, a solid block of aluminium alloy was machined to form the crankcase, a detachable bottom plate being spigoted in, and secured by countersunk screws. The block was bored out on its vertical centre to remove as much superfluous metal as possible, after which it was bolted to an angle plate, and bored on the main shaft and camshaft centres, these holes, of course, breaking into each other, like a figure 8, or the dear departed cottage loaf.

The connecting-rods in an engine of this type must either be forked or offset, unless the cylinder centres are staggered, which is, generally speaking, the more desirable in i.c. engine where maximum loads are heavy. I chose offset rods in this engine for the sake of simplicity, and with the relatively light loading under steam, they appear to be quite satisfactory.

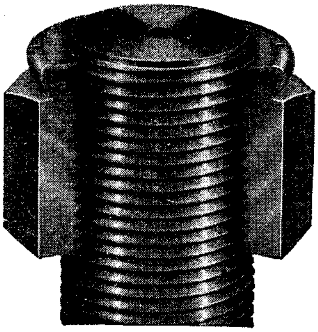
The working parts are robust and not likely to break down or give trouble, so long as they are kept well lubricated. There may be objections to the complication entailed by gearing to drive the camshaft ; I have made some remarks about the mechanical weakness of gears used for driving valves on certain types of steam engines, but this does not apply so much in the case of plain spur gears, which are totally enclosed and lubricated, and may be made of any reasonable width to produce low tooth loading. I propose to give detail drawings of the engine in its final and most satisfactory form, as determined by experiments made with my fabricated "hook-up."

(*To be continued*)

TRADE TOPICS

2½-in. Gauge Locomotive Blueprints and Castings

Bond's o' Euston Road have favoured us with a set of their blueprints for a 2½-in. gauge L.M.S.R. Duchess-type 4-6-2 locomotive and tender. There are fourteen sheets in the set, covering general arrangements in side and end elevation, and all the principal details of a very fine-looking locomotive. The drawings have been thoroughly well prepared, arranged in an orderly manner and are very easy to follow; they represent an enormous amount of time and labour at the drawing-board.



Bond's supply all the castings and materials required for this locomotive, and we have inspected samples of them; we can testify to their excellent quality.

The engine is a two-cylinder one, and the cylinder castings are of ingenious design, so arranged that the steamchest joint is inclined at an angle; this arrangement ensures that, when the cylinders complete with steamchest are in position on the engine, and inspection of the valve is necessary, all that is required is the removal of the cleading-plate and valve-rod glands and the steamchest can be taken off, leaving the valve on the port-face ready for inspection. This can be done with the engine in steam, provided the regulator is kept closed.

Tapered tube for the boiler-barrel is available; this is not a very usual commodity on the market, but its use not only saves the constructor a lot of time but ensures that full advantage can be taken of the excellent properties of a tapered boiler.

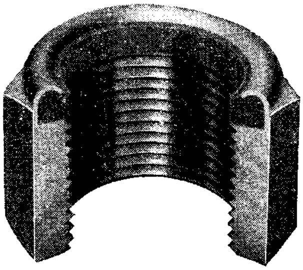
The drawings show that the whole engine has been well designed, and it should be worth building by anybody who requires a satisfactory working unit on 2½-in. gauge.

New Model Fittings and Tools

The above-named firm have also introduced several items that should be of interest to our readers. Among a useful range of steam fittings, we would call attention to: a water-gauge, of which a special feature is water-ways of large diameter; a "pop" safety-valve to ½-in. scale, having both the release and the "pop" adjustable; a plug-cock which is ingeniously arranged to be self-cleaning and leakproof.

There is a hardened steel ratchet for miniature mechanical lubricators, and it should give very long service in use.

For the workshop, we have noted a useful range of vee-pulleys in aluminium alloy having diameters ranging from ¾ in. to 1½ in. and a bore of ¼ in. In addition, we should mention a steel tool-holder in which the tool is held in an inclined slot so that the tool may be held rigid but with the point inclined towards the work, enabling a cut to be made right up to the chuck jaws, if necessary, without either the tool-holder or the slide-rest fouling the chuck.



For the model yachtsman there are various sizes of nylon yacht cord and a new, light but extremely strong sail-cloth which should prove popular.

Stop Nuts

The need for some means of preventing nuts working loose under heavy strain and vibration is encountered in nearly all kinds of mechanical engineering, and attempts to find an ideal solution to this problem have been the subject of innumerable patents. Of the many devices at present in use for this purpose, none have been more successful in practice than the well-known Simmonds and Pinnacle nuts, which have been universally adopted in many engineering industries. Both these nuts introduce frictional methods to prevent loosening, the former having an inserted fibre ring which grips the thread of the bolt, and the latter a stainless-steel spring diaphragm which operates in the same way; this is an advantage where the nuts have to withstand high temperatures, and the Pinnacle nuts are recommended for use on parts of engines which have to work at temperatures of up to 500 deg. C.

These nuts have not hitherto been available in small quantities, but we are now informed by Messrs. Burt Bros. Ltd., Crescent Copper Works, Edward Street, Parade, Birmingham, that they are offering bags containing one gross of assorted 2-, 4- and 6-B.A. nuts of either type, price 5s. per bag.

*Hacksawing Minus Hard Work

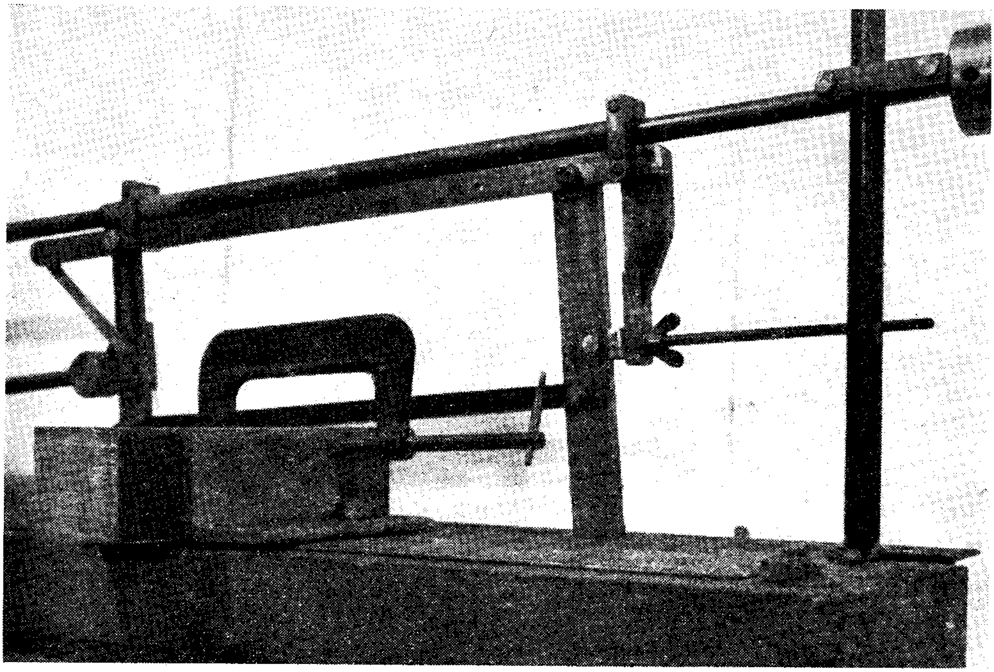
by J. W. Pattison

THE next part to make is the upper guide-arm, this is a length of steel rod with two flats either milled or filed at one end to take the bent strips of steel which form the yoke. These can be filed up from ⅛-in. material drilled and reamed for the hinge pins and carefully bent to shape. Put a length of bar through the eyes and cramp to the guide-rod, and when lined up, drill the holes and rivet altogether with ⅛-in. rivets.

It may be worth mentioning here that the machine could be made a little more compact when out of use by sawing through the base-board just ahead of the table and covering the joint with a substantial hinge. The guide-arm could then be swung clear, followed by the table. This alteration, however, would rob the machine of being ready for instant use. The reason for mentioning this detail here is, that should this alteration be carried out, it will be desirable at this stage to make the yoke somewhat longer, so that the guide-arm could be swung to an almost vertical position.

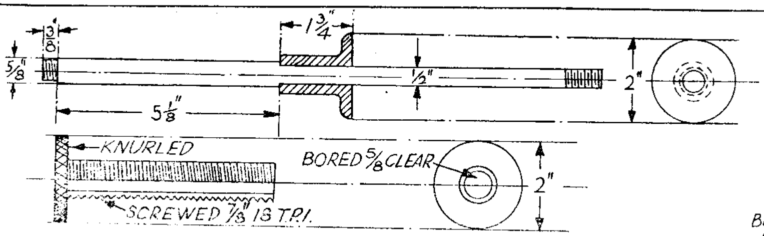
Having completed the yoke, drill a couple of holes and tap them 2-B.A. near the other end of the guide arm to accommodate screws which, together with a bridge piece of ⅜-in. × ⅛-in. material, will form a stirrup. Short lengths of thin tube, a trifle over ⅝ in. long are slipped over the screws before the bridge-piece is tightened up, to act as distance-pieces. This stirrup spans the vertical column, locating the guide-arm thereon, whilst allowing unrestricted up and down movement. Another small hole to suit a taper or cotter pin is drilled in the extreme end of the guide-bar to prevent any extra weights, if used, falling off. The weights are simply discs of steel, suitably drilled to slide on the bar.

Going back to the yoke end of the bar, there is a bearing block, a screwed sleeve and a supporting column. Starting with the column, this is a length of bright mild-steel rod shouldered down at one end to take the collar, also turned from steel bar. The lower turned end of the column is screwed to take the holding-down nut, and at the other end is a thin lock-nut screwed tightly on its thread. The screwed sleeve may be turned from solid, or a piece of tube used instead with the knurled disc brazed on. It may be

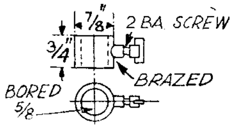


Starting on a piece of 2 in. black bar

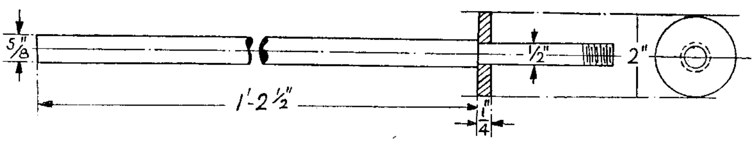
*Continued from page 718, " M.E.," December 8, 1949.



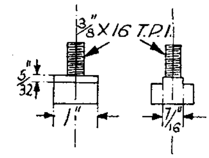
Pivot bearing support



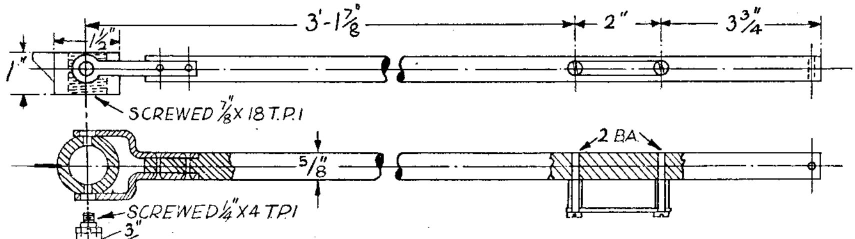
Depth stop



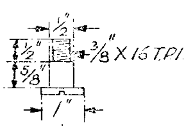
Guide-bar support

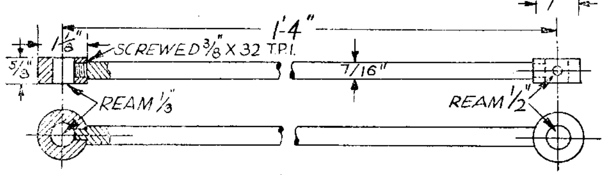


Vice bolt

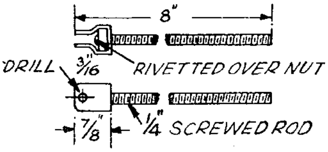


Saw frame guide-bar

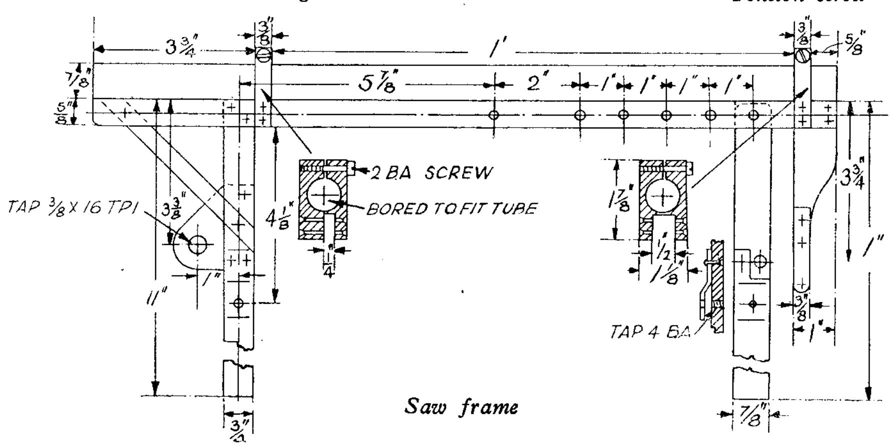




Connecting-rod

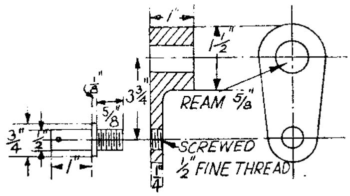


Tension screw



Saw frame

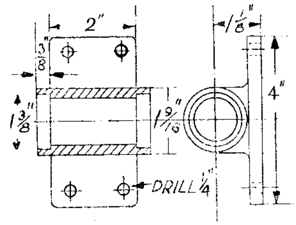
screwed with any convenient thread provided the root diameter does not weaken the tube. The bearing block may be of brass or steel, being turned, bored and screwcut to suit the thread on the tube, and finally parted off. It has two flats which can be either filed or milled, to take the yoke end of the guide-rod and these are drilled and tapped $\frac{1}{4}$ in. × 40 t.p.i. to take the pivot pins. The latter are turned from steel



The crankpin and crank

and may be case-hardened or just left soft. A saw-cut is made in the rear side of the block, into which a shaped piece of brass is soldered to act as a pointer. The height gauge is merely a length of square rod marked in fractions of an inch and screwed to the wooden block. To get the hole in the baseboard correctly positioned for holding down, lay a length of $\frac{1}{4}$-in. flat bar in the guide slot with one end resting on the wood block, and mark off from the nearside of the bar, then drill through both block and base-

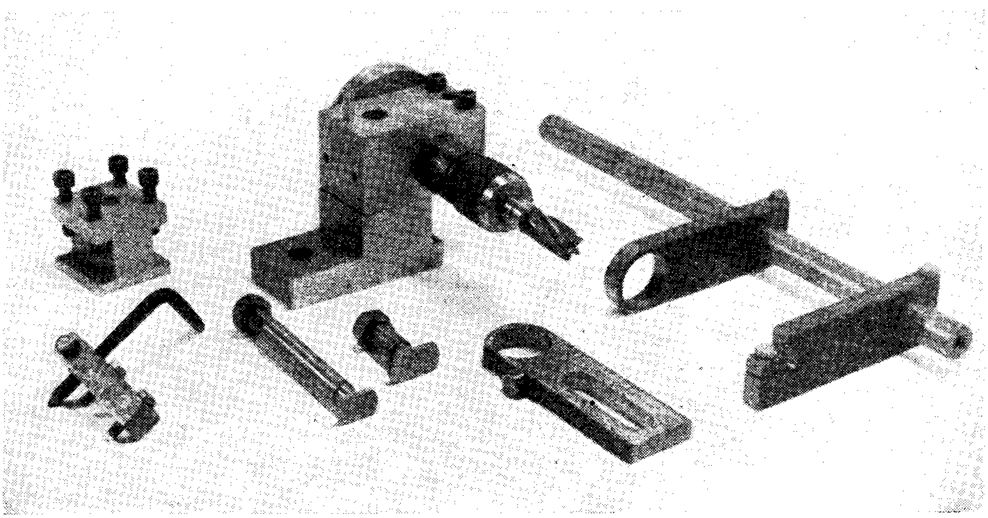
slot. Likewise the rear side of the blade is directly under the centre-line of the guide-bar. Another point to be noted is that, should the hole for the 6-in. blade be dispensed with, a corresponding amount can be taken off the tension screw. All frame material is of steel $\frac{1}{4}$ in. in thickness and riveted where necessary with $\frac{1}{8}$-in. rivets, the angle of the fixed arm being strengthened by a strip of $\frac{3}{8}$-in. × 1/32-in.



Crankshaft bearing

steel to relieve the strain on the rivets. The tube working on the upper guide arm can be of quite thin material since it doesn't have to carry the strain of the saw-blade, and due to its long length has ample wearing surface. In my own machine I used an odd length of brass tube about 18-gauge and an easy sliding fit on the guide bar.

To make up the frame take the horizontal bar first and drill the holes $\frac{3}{16}$ in. to correspond



Some finished components. Flat surfaces cut on the machine required only a final polish

board. If everything is correct the centre-line of the guide arm should lie directly over the nearside of the lower guide slot. If the hole in the wood is out, enlarge it and adjust the guide-arm until it is in the correct position, then tighten up.

The next step is the saw frame and it will be noted that the construction allows the saw-blade to come to rest on the table with the back of the blade flush with the nearside of the guide slot; in other words it just cannot drop into the guide

with the various sized blades. Note that the three vertical arms are all attached to the back of this bar. Take the fixed vertical arm which is 11 in. long, cramp in place, drill and rivet up solid. File up the triangular piece which carries the connecting-rod, drill and tap $\frac{3}{8}$-in. × 16-t.p.i., cramp it in position against the rear of the vertical arm. Drill and put in the top rivet first, then add the strip of $\frac{3}{8}$-in. × 1/32-in. steel to the face of the vertical arm, put a rivet through

the lot and finally add the bent saw-blade clip, and complete with another couple of rivets. Then put a slip of metal equal to the thickness of a saw-blade under the raised part of the clip and drill and tap 4-B.A., after which open out the hole in the clip to clear 4-B.A. Only one rivet is required to join the 1/32-in. strip to the horizontal bar. Make up the straining bar for the opposite end; this has two ⅛-in. cheeks riveted on its lower end to thickness it and is drilled ¼ in. clear. The upper end can now be attached to the rear face of the horizontal bar with a couple of rivets placed near the extreme edge. The adjustable arm is 1 ft. long, drilled at the top for a $\frac{3}{16}$-in. bolt and another hole is offset near the saw-blade clip to take the tension screw yoke. The tension screw is a length of screwed rod with a square ¼-in. nut screwed on tightly, and the rod riveted over. The yoke is bent up from steel strip and drilled $\frac{3}{16}$ in. This leaves only the cramps to complete the frame, and care should be taken in the positioning of the slots. To make them, it is best to follow this sequence: square up a piece of ⅜-in. steel plate to 1⅞-in. × ⅞ in., mark off for rivets, tube and screw. Bore out the hole for the tube, drill ⅛-in. holes for the rivets and No. 25 for the screw; saw or mill out in one of them a ½-in. wide slot centrally beneath the tube hole and in the other a ¼-in. wide slot to one side of the centre line. Rivet both in place on the frame with the tube in position, then remove the tube and run a saw down into the tube hole. Finally, counterbore one half of the screwhole as far as the sawcut and tap the other half 2-B.A.

The connecting-rod is quite straightforward, being merely a length of $\frac{7}{16}$ in. diameter rod turned down at each end and screwed ⅜ in. × 32 t.p.i. The eyes are got out of hard brass rod, drilled and reamed, and holes tapped for the rod, not forgetting a couple of oil holes.

The only other minor item is the depth stop, also turned, bored and parted off from brass rod, a short piece being brazed on the side which is drilled and tapped 2-B.A. for the pinching screw. The latter can be a standard cheese-headed screw with a small piece of brass soldered in to form a thumbscrew.

Finally, there is the crankshaft. The housing of this may be an alloy casting, as in my case, or simply built up from tube brazed to a baseplate. It is bored out to take the light pattern ball bearings, ⅝ in. bore × 1⅜ in. outside diameter. The shaft is a short length of bright steel bar and the crank again an alloy casting. The crankpin is turned to the sizes shown, and should be screwed tightly into the web and lock-nutted. Put on the connecting-rod, mount the crankshaft assembly on its wood block and carefully line all parts up square. The saw frame, when extended, should have the rear eye of the saw-blade 1¼ in. behind the face of the vice. Having got everything set correctly, drill the holes through the block and baseboard and bolt up securely. The driving wheel in my case is 8¼ in. diameter.

A Domestic Refrigerator

(*Continued from page* 756)

Anneal about ½ in. each end of the *A* pieces, and swell out to ⅜ in. i.d. using the clamps and anything the right size for a drift, anneal all over and bend it round a 1⅜-in. bar, getting the ends level. *B* and *C* are easier. Fifteen fins are next made from thin sheet copper. Don't let them touch the top and bottom of the case as shown, or they will buzz like a hive of bees, 6½ in. will be long enough. They can all be clamped together and drilled 25/64 in. It makes it a lot easier to sweat the fins on if they and the coils are tinned before assembly. It is now a simple matter to slide all the fins up to one end, jam the *A* loops on and run a spot of "Easy-flo" around each joint. The fins can be slid down one at a time and soft-soldered at every hole, thus giving the maximum heat transfer. The case is knocked up from strips of aluminium left over from the inner cabinet. Test and bake till quite dry; the ends can be plugged with wooden plugs for the time being.

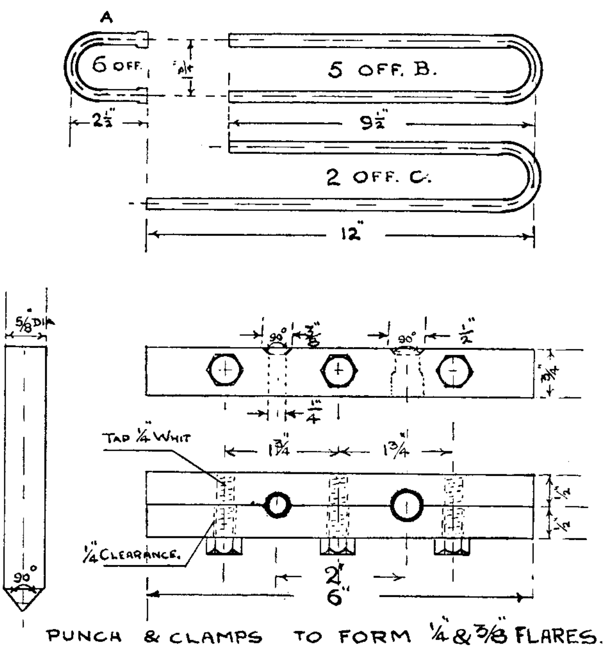


Fig. 10A

(*To be continued*)

IN THE WORKSHOP

by "Duplex"

52—Machining V-Pulleys

V-PULLEYS play an important part in the small workshop, as they are so generally used for the V- or round-belt drives fitted to small machine tools.

It is, therefore, often found necessary to machine one or more of these pulleys when, for example, making up the castings of a small drilling machine or fitting supplementary drives to existing machines.

Although the smallest pulleys can be made from round mild-steel bar, cast-iron has much better wearing qualities, and it is this material, in the form of sand castings, that is generally used for pulleys of medium or large diameter.

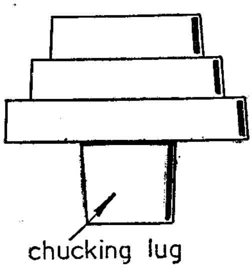


Fig. 1. Showing draw or taper in a pulley casting

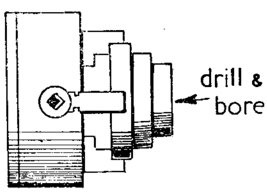


Fig. 2. Casting held in the four-jaw chuck for machining the bore

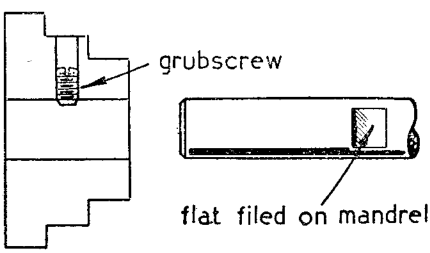


Fig. 3. Method of securing the casting to a chucking mandrel

With pulleys made by a process of die-casting or pressed to shape from sheet steel, we are not, here, concerned, as these are bought in the finished state and ready for use.

A cast-iron pulley blank is best freed from adherent scale and sand by a pickling process in mineral acid, for these substances tend rapidly to blunt ordinary high-speed steel tools and, besides, the abrasive swarf formed when turning is injurious to the working parts of the lathe.

Hydrochloric acid, known also as spirits of salts, when diluted with some ten parts of water forms a good pickling medium, and the fumes emitted are not so noxious as those produced by nitric acid. Diluted sulphuric acid is also often used for pickling castings, but, here, there is always the danger of a violent eruption should water be added to the acid instead of the acid to the water. A glass or glazed vessel must be used for the pickling operation, and the castings should remain immersed for an hour or more to ensure complete removal of the hard scale. After they have been pickled, the parts should be well washed in running water to remove all trace of acid and so prevent any further chemical action. If the castings have not been properly fettled, any gross irregularities should be removed with an old file.

Lathe Tools

Tungsten carbide tipped-tools will be found a great boon when machining iron castings in the lathe, provided that a tool of the correct grade is employed. A 4 in. diameter pulley can readily be turned in this way when using the slow, direct mandrel speed of 200 r.p.m. or more ; in addition, the cutting edge of the tool will be unaffected by any remaining scale or hard spots in the casting. Further advantages are that much time is thereby saved and a good surface finish is more readily imparted to the work. It should, however, be borne in mind that tungsten carbide is a rather brittle substance, and, for this reason, heavy cuts should not be taken on irregular work, as fracture of the tool's edge may occur if subjected to shock.

The Machining Operations

If a sand-cast pulley blank is examined, it will be seen that, as represented in Fig. 1, it usually has a slight draw or taper towards both ends which is necessitated by the casting process.

This taper must be taken into account when mounting the work in the chuck, for an insecure hold will be obtained if the part is gripped by the outer ends only of the jaws.

When holding castings of this sort, it is preferable to employ the four-jaw chuck, as this will give a firmer grip than the three-jaw self-centring chuck.

Where, as shown in Fig. 1, the casting is provided with a chucking lug, and this is to be used for turning the rest of the part, the lug should first be turned parallel by gripping the work elsewhere, and taking a series of very light cuts.

Needless to say, the casting should be as nearly

as possible centred in the chuck so that it will hold up to the required dimensions during the subsequent machining.

With the work held either by its chucking lug, or by its outer diameter as illustrated in Fig. 2, the bore is formed by drilling, followed by boring to slightly less than the nominal diameter to allow for reaming to size. A thousandth of an inch allowance for each quarter inch of the bore diameter will be found approximately correct. Where a reamer of the appropriate size is not available, the bore must, of course, be finished by a boring operation. Before the work is removed from the chuck, as much of its surface as possible should be rough-turned.

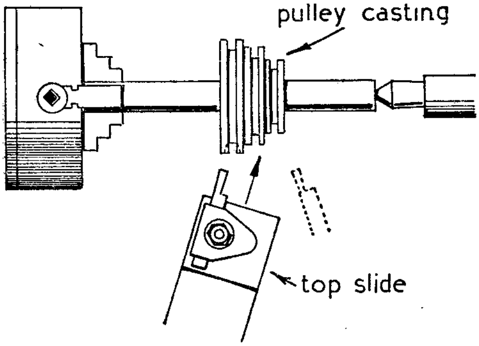


Fig. 4. Setting over the top-slide to machine the belt grooves

The next operation is to mount the pulley on a mandrel for finishing it to size and cutting the belt grooves.

For this purpose, either a standard, hardened, taper mandrel is pressed into the bore to afford a secure drive, or a piece of round mild-steel, held in the chuck and supported by the tailstock, is turned to fit the pulley bore. In the latter case, as shown in Fig. 3, it is usually advisable to fit the pulley with a grub-screw which, by bearing on a flat filed on the mandrel, prevents the pulley shifting during the subsequent turning operations.

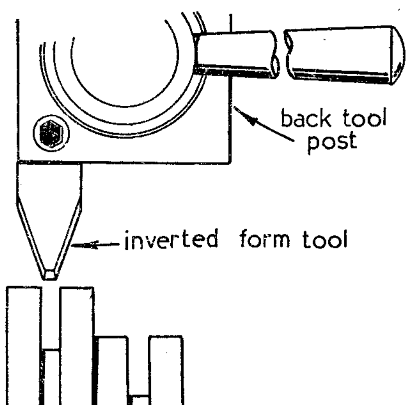


Fig. 6. A form tool used to machine the groove at a single operation

After the pulley steps have been turned to the finished diameter and length, a parting tool is fed in on the centre-line of each step and to the full depth of the belt groove.

It should be borne in mind that, when a high-speed steel tool is substituted for the tungsten carbide tool, it will probably be necessary to engage the back gear; also, if the parting tool is mounted in the inverted position in a back tool post the machining will, as a rule, be more easily carried out.

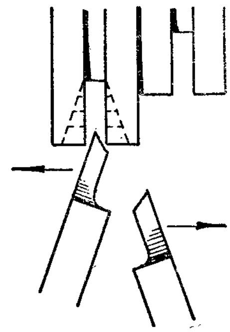


Fig. 5. Knife tools used to machine the pulley grooves

Turning the V-Grooves

Before the grooves are machined, the value of the included angle must be determined in accordance with the type and make of V-belt fitted. The angle of the V will also vary with the diameter of the pulley, for when the belt is bent round a small pulley it tends to bulge at its inner part and so make the contact surfaces more nearly parallel.

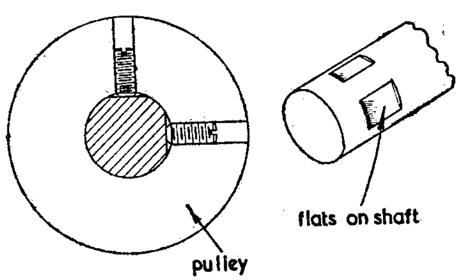


Fig. 7. Securing the pulley to the shaft with two grub-screws

In this connection, Messrs. Fenner, for example, recommend the following pulley angles for their V-belts of $\frac{3}{8}$ in. width :—

Pitch diameter of pulley	*Groove angle*
$1\frac{1}{4}$ to $1\frac{3}{4}$ in.	32 deg.
2 to $2\frac{1}{2}$,,	34 ,,
3 in.	36 ,,
$3\frac{1}{2}$ in. upwards	38 ,,

An included angle of about 36 deg. will give the best results with round belt drives; if the angle is greater, increased belt tension is required

to avoid slip, and a smaller angle tends to make the belt cling as it leaves the pulley on the non-driving side.

To machine the V groove to the required included angle, the top-slide, as illustrated in Fig. 4, is set over to half this angle, and the parting tool is fed inwards in a series of cuts until the groove at its outer diameter is machined to half the finished width. The top-slide is

If, even then, chatter arises, the mandrel handle may be employed to turn the lathe more slowly, and this is continued until the tool ceases to cut.

Where the lathe is sufficiently rigid and the tool is, preferably, mounted in the inverted position, a double-edged form tool may be used, as represented in Fig. 6, to cut both sides of the V-groove to the correct angle at a single operation.

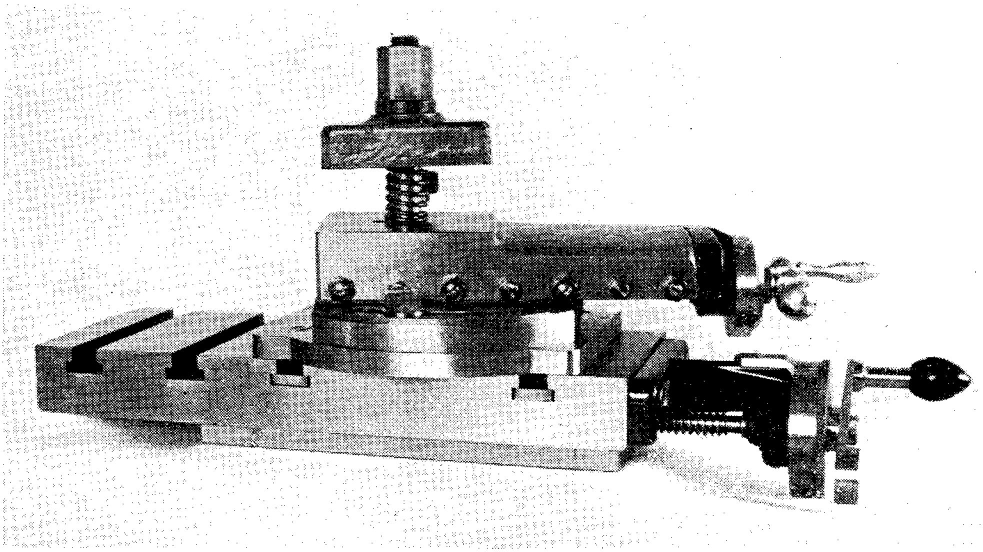


Fig. 8. The top-slide set over to 15 *deg. on the cross-slide soleplate*

then set over in the reverse direction, and the turning operation is repeated to finish the groove to its correct width and angularity.

To obtain an accurate setting, it may be found advisable to adjust the position of the top-slide with a protractor in contact with both the face of the chuck and the V of the slide.

Formerly, it was the common practice to construct the slide-rest so that the top-slide could revolve for a complete circle; and, to facilitate the operation of the top- and cross-slides when set parallel, or nearly so, the feed handles were made in the form of detachable keys fitting on the squared ends of the feed-screws. Nowadays, some top-slides have only a limited range of angular movement, admittedly quite sufficient for all ordinary work, but not enough for machining pulley grooves in the manner described. When this is found to be the case, the V-grooves can be correctly cut by using what amounts to a form tool set to the correct angle.

Fig. 5 shows how right- and left-hand knife tools can be employed to cut the grooves by taking a series of cuts in the direction of the lathe axis. When, in this way, one side of the groove has been formed to the full depth, the machined surface is finished by allowing the tool to cut along the whole length of the groove face, but, to avoid chatter, the lowest speed of the back gear should be used.

Any surfaces which have been only rough-turned can now be finished by taking a light cut at moderately high speed with a round-nosed tool; if necessary, the pulley is mounted on a stub mandrel so that it can be reversed and the finishing cuts carried right up to the bore. It is advisable, especially when the pulley is required to operate at high speed, to machine the casting all over in order to balance the component.

The surface finish will be improved if a file is applied to the rotating work and this is followed by a strip of oiled emery cloth, backed by a file and pressed firmly against the pulley. For light drives the pulley can be secured to the shaft by means of a single grub-screw, but two screws, fitted at right-angles to one another, should be used where the duty is heavy. To afford a firmer hold, it is advisable, as shown in Fig. 7, to form flats on the shaft for the points of the grub-screws; this also ensures that the burrs set up on the shaft by the screw points will not at any time interfere with the removal of the pulley.

An Attachment for Setting over the Top-slide

As has already been mentioned, it is not possible in all lathes to set over the top-slide sufficiently for machining the V-grooves in pulleys.

In the Myford ML7 lathe, for example, the

curved slots used for bolting down the top slide lie beyond the margins of the cross-slide when the top-slide is set at right-angles to the lathe axis. With the slides in this position, it is, therefore, not possible to drill additional bolt holes in the cross-slide for securing the top-slide. As the easiest solution appeared to be the provision of a bolting face wider than the cross-slide, a detachable soleplate was made to fulfil this purpose.

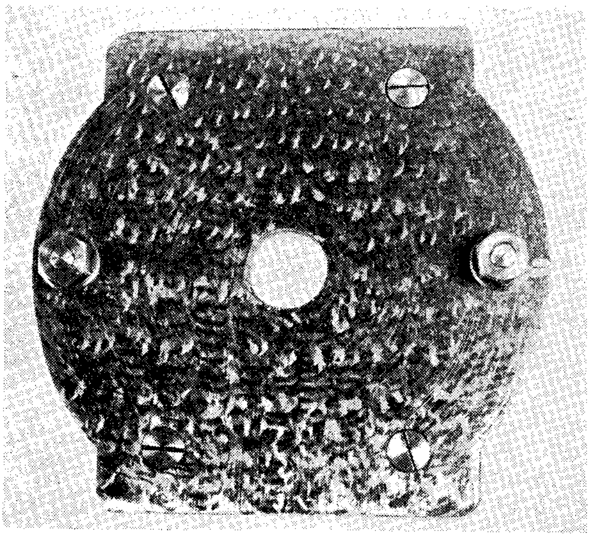


Fig. 9. The upper surface of the soleplate

Since this attachment was made, some months ago, it has given good service both for machining V-pulleys and when screw-cutting with the top-slide set over to half the included angle of the thread.

The appearance of the soleplate when fitted in place is shown in Fig. 8, and, here, the top-slide has been set over to an angle of 15 deg. in relation to the cross-slide. This allows the top-slide to be operated without interference from the cross-slide feed, but, if a setting below 10 deg. is used, the cross-slide keep-plate and feed-screw may have to be temporarily removed ; this entails setting the cross-slide by hand and then clamping it in position by means of its locking or gib-adjusting screws.

Reference to Figs. 9 and 10 should make clear the method of construction, and the dimensioned working drawings are given in Fig. 11.

Although the machining should present no difficulty if correctly planned, there are some points in the methods employed to which attention should, perhaps, be drawn.

In the first place, provision must be made for mounting the work in the lathe without interfering with the permanent constructional drill holes. The material used for making the soleplate was a piece of mild-steel $4\frac{1}{2}$ in. long, 5 in. wide and $\frac{1}{2}$ in. thick, but, to keep a $\frac{5}{16}$ in. square tool at centre height, the thickness of the finished plate must not exceed 11/32 in.

After the edges of the material had been filed square, its surface was painted with marking-out fluid to enable the drilling centres to be set out in accordance with the drawing.

At each corner a hole was drilled and tapped $\frac{1}{4}$ in. B.S.F. for securing the work to the lathe faceplate. The two register pin-holes were drilled 3.1 mm. in diameter, but the remaining six holes at the periphery were drilled $\frac{1}{8}$ in. to allow a pin-drill, with a $\frac{1}{8}$ in. diameter pilot, to be used for forming the recesses to receive the heads of the two sets of fixing screws.

The central bore is located by means of a centre drill, and the recess so formed is used to centre the work on the faceplate with the aid of the centre-finder. When the work has been secured to the faceplate with four $\frac{1}{4}$-in. B.S.F. hexagon-headed screws, the bore is drilled and then bored to exactly 0.750 in. diameter.

It now remains to face the work on both sides, and to reduce it to a finished thickness of $\frac{5}{16}$ in. ; and if the automatic cross-feed is used, not only will the operation be less tedious but a better surface finish will probably result.

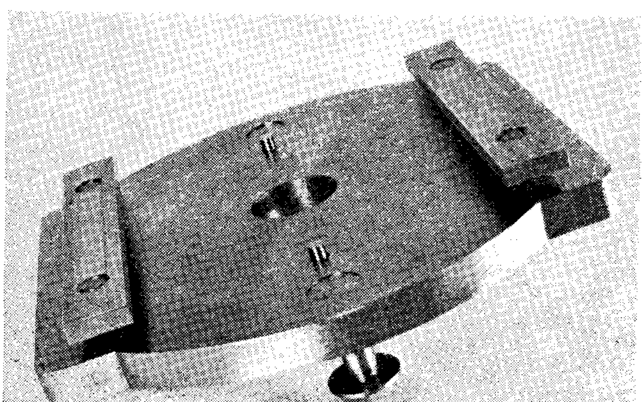


Fig. 10. Showing method of securing and locating the soleplate

The pin-drill is next employed to form the $\frac{3}{8}$ in. diameter recesses a few thousandths of an inch in excess of 5/32 in. deep to receive all six screw heads. The four corner holes for the screws (*B*), Fig. 11, fixing the plate to the cross-slide, are opened out to $\frac{1}{4}$ in. clearing size, but the two remaining holes for the top-slide fixing bolts, (*A*), are drilled with a letter D-drill and

then partially reamed to make the screws a press fit in the plate. The two sets of fixing screws are turned in accordance with the drawings (*A*) and (*B*), Fig. 11.

The two bolting strips (*C*) receive the four screws (*B*) for securing the plate to the cross-slide, but, if preferred, these strips can be made in the length to engage both the soleplate and the cross-slide.

The remaining operation is to mark an index line on the soleplate for use with the angular scale engraved on the base of the top-slide.

The top-slide is, therefore, set to the zero position at right-angles to the lathe axis in the following manner and as represented in Fig. 12. The upper portion of the top-slide is removed and a straight-edge is placed against the face of the chuck ; the top slide is swivelled until the bevelled edge of the straight-edge makes continuous contact with face of the slide V, and the slide is then fixed in this position. Paint the soleplate opposite the top-slide zero mark with marking fluid and mark the zero position with a scriber. Grip the soleplate in the vice and use a toolmaker's clamp to secure a small square to register with the scribed mark. When forming a setting line of this sort, it will answer well if a fine line is scribed with a sharp-pointed scriber.

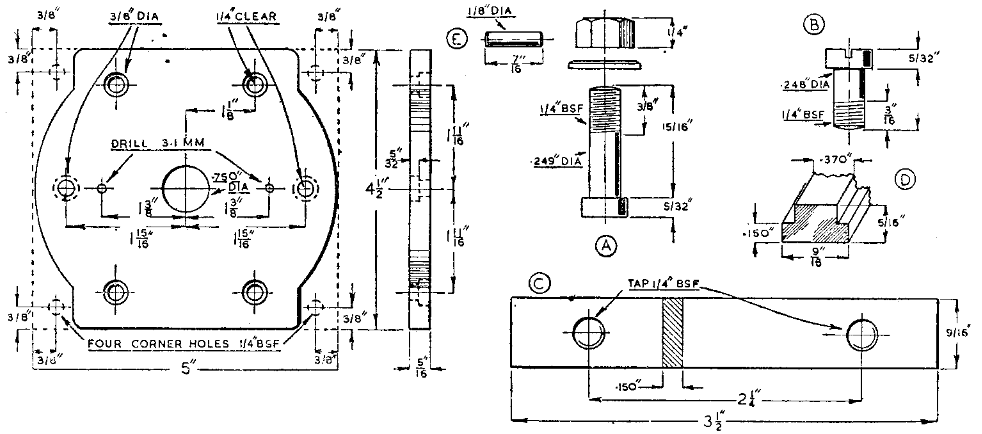


Fig. 11. Working drawings of the soleplate and its parts

form shown in Fig. 11 (*D*), and a greater length of thread engagement will then be obtained.

On completion of the machining and before fitting the register pins, the soleplate is cut and filed to the shape shown in the photograph and in the drawing ; the edges are then draw-filed and may be further finished by smoothing with a strip of worn emery cloth backed by a file.

To make sure that the machining has produced flat surfaces, the soleplate should be tested on both its sides against a surface plate thinly smeared with marking compound. Any irregularities are removed by hand scraping, and at the same time, if desired, the surfaces of the plate can be given a frosted finish by plying the scraper to form rows of crossing lines made up of short scraper marks.

To fit the register pins locating the plate on the cross-slide, a plug is turned to fit into both the plate and the bore in the cross-slide, and the plate is then secured in position with its fixing screws. The 3.1 mm. drill is now entered in the holes previously drilled in the plate and is fed into the cross-slide for a distance of some $\frac{1}{4}$ in. After removal of the plate, the holes drilled in the cross-slide are opened out to size by using a centre-drill with a body diameter of $\frac{1}{8}$ in.

The inner ends of the holes drilled in the plate can be enlarged with the tip of a $\frac{1}{8}$ in. diameter reamer to allow the register pegs to enter part-way. The register pegs, $\frac{7}{16}$ in. in length and made of $\frac{1}{8}$ in. diameter silver-steel, are pressed into the plate from below, and when in place they should be found to engage accurately in the cross-slide with the central plug fitted in position. If desired, a new central register plug can be fitted permanently to the top-slide of sufficient

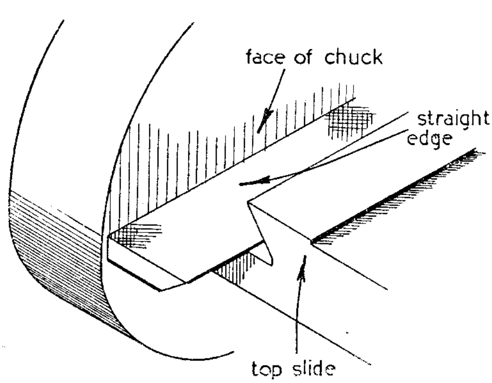
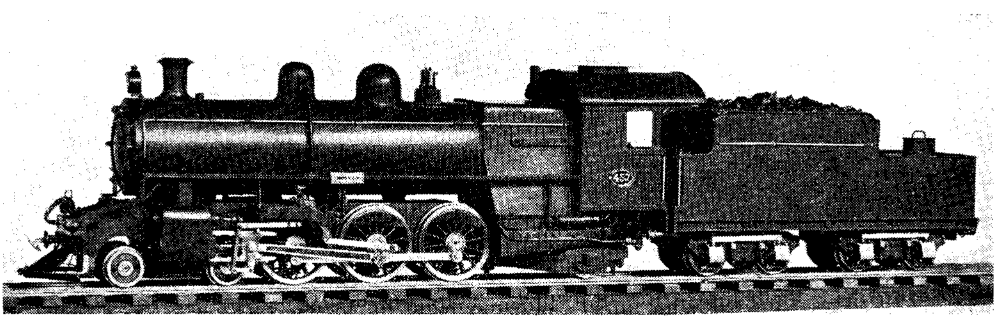


Fig. 12. Method of setting top-slide at right-angles to the lathe axis

Querists Ahoy! — by "L.B.S.C."

BEFORE proceeding with construction notes this week, I would like to have a word or two with our friends the query-merchants. Ever since my first weekly article appeared in September, 1924, I've done my best to disseminate *reliable* information to all who have requested it, in an earnest desire to keep faith with the good folk who follow my notes. I have sent thousands of friendly letters all over the world; but with the increase in our circulation, especially during the last couple of years or so, correspondence has become an intolerable burden. Some readers have recently complained that replies to their queries have become kind of snappy and "staccato," compared to friendly letters of past years, and want to know if anything is wrong. The only thing that is wrong, is just that I haven't the time available for long letters. I have to do everything—writing, drawing, correspondence, and experimental work—by sole aid of my own hands and nearly-worn-out noddle; I am compelled to cut down on something, and correspondence has to suffer, being the least important. That is all there is to it!



"Fayette's" Australian sister, "Mary Ellen"

You know the old saying that "the cobbler should stick to his last." I stick to mine, keeping to writing about locomotive-building and operation, and to things appertaining to them, such as an occasional note or two about the permanent way, and so on. I don't write about traction or stationary engines, discourse on petrol or Diesel topics, or flirt with Milly Amp; though I could—and this is plain fact, not idle boasting—"put the cat among the pigeons," in those branches of engineering, in the same way as I have done in the locomotive field. May I therefore, beg that prospective querists will no longer regard me as an animated edition of *The Encyclopedia Britannica*, and confine any queries to locomotive-building and operation only; also cut them to the bare minimum. Below are the types of query to avoid.

A Few Samples

Will I please explain what I did to the carburettor and ignition of my 13-year-old 12 h.p. gasoline cart, to enable it to use the least amount of petrol when running at 50 m.p.h., and yet have power enough to take any ordinary hill in its stride? The firm who built the car would like to know the answer to that one, but I'm not telling. Anybody who doesn't believe she can do it, had better apply to our friend the K.B.P. or our commercial manager, for confirmation—*they know*!

Will I please give full instructions on how to convert a domestic boiler from coke to oil firing? Querist keeps a garage, has barrels full of waste sump oil, and would like to utilise it as fuel.

Please forward a complete list of tools, etc., to start locomotive-building, advise on the make of lathe to purchase, and include a diagram of a suitable layout for a garden workshop about 10 ft. by 8 ft. Also suggest a means of continuously heating same, to prevent rusting?

Querist lives in country, off electricity supply. Has bought a used gas engine—diagram of same enclosed. Will I please supply full instructions on how to run same on paraffin and water (like the one I had at Norbury), what size and type of dynamo will it drive, and please give diagram of switchboard and wiring?

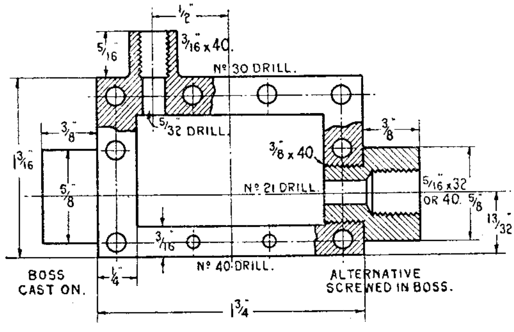
And so *ad infinitum*!!

A Lot for his Money!

A new reader in U.S.A. got my address from a friend, and sent me a letter, enclosing a draft on a British bank for £3. He was just going to do a bit of locomotive designing, from ¾-in. scale to 1½-in. scale, and would I please send all my formulae and rules for determining cylinder bore and stroke, sizes of ports, valves and passages, valve-gear dimensions, lap and lead arrangements, etc., for two-, three-, and four-cylinder engines. Also kindly supply all data for boilers of same, gauge of material, for both copper and steel boilers, diameter and arrangement of tubes and flues, and what would be the American equivalent for Sifbronzing. Also would I please include an autographed photograph of myself! What all this really amounted to, was *the sale of all the knowledge and experience I have accumulated*

in 60 years of actual locomotive building, for the amount of his draft. I just returned it, with a note advising him to send five dollars to Uncle Sam, and ask for the formula for making atom bombs!

Anybody who is absolutely stuck, and must send queries, please make them as short as possible, number them, take a copy, and don't forget to enclose the return ticket (my few personal friends excepted). I'll do what I can to help out; but if the reply is only a few words, just blame old Father Time. He is the culprit—not your humble servant.

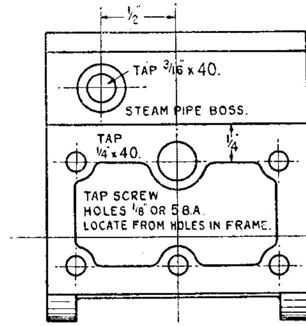


Steam chest

An Australian Version of "Fayette"

The $2\frac{1}{2}$-in. gauge "Fayette" which I described about 21 years ago, after having built one, has formed the basis of many other engines of similar wheel arrangement and size. Builders have varied the general arrangement and details to suit their own requirements, whilst keeping to the given layout of cylinders, valve-gear and other vital parts, thus ensuring that the performance of the finished locomotive will come up to expectations. Such an engine is illustrated here, and is of exceptional interest because it represents a "$\frac{3}{4}$-in. scale" engine running on $2\frac{1}{2}$-in. gauge. The builder, Mr. J. W. Henderson, of Wahroonga, N.S.W., wanted to build a small edition of the West Australian Govt. Railways, Class P Pacifics, a product of the railway's own shops at Midland Junction, W.A.; so he adapted the "Fayette" works to the West Australian outline. The reason she is "$\frac{3}{4}$-in. scale," is because the gauge of the W.A.G.R. is 3 ft. 6 in. only, and makes a $2\frac{1}{2}$-in. gauge engine come out a fairly hefty job.

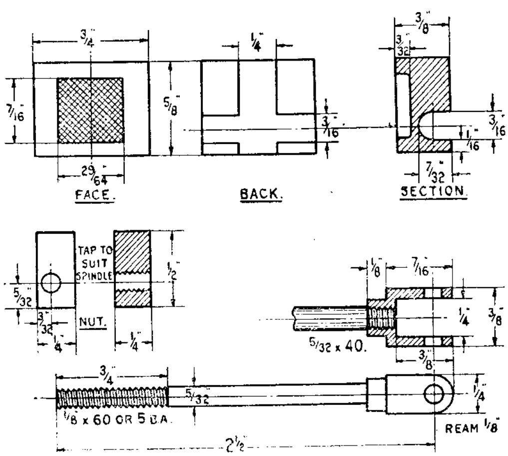
The chassis is much the same as "Fayette's," but the cylinders are bigger, being 1-in. bore and $1\frac{1}{4}$-in. stroke. Baker valve-gear is fitted, the rods and links being made from steel cut from an old circular saw, which naturally would be tough and hard-wearing material. The pins are natural silver-steel, and although the engine has been running on and off for nearly sixteen years, wear is practically nil. The engine has done some good hard work; during the war she raised money for troop comforts, giving penny rides to children, often twelve at a time. The coupled wheels are $3\frac{3}{8}$ in. diameter, bogie wheels $1\frac{5}{8}$ in., pony and tender wheels $1\frac{7}{8}$ in. The boiler is bigger than the original "Fayette's," being 4 in. diameter and 19 in. long. It has nine $\frac{7}{16}$-in. tubes, two $\frac{5}{8}$-in. superheater flues, and five $\frac{1}{2}$-in. water tubes in the combustion chamber; and easily maintains a working pressure of 70 lb. per sq. in. Practically nothing has been needed in the way of repairs, save for new bushes in the connecting- and coupling-rods; and the only additions made, have been a mechanical lubricator and a simple donkey pump. Hearty congratulations to our good friend on his realistic and successful handiwork.



Bolting-face of cylinder

Beginners' Corner—Cylinder Covers for "Tich"

Before machining and fitting the cylinder covers, there is one little filing job to do, viz. establish communication (as the radio announcer would say) between the drilled passageways and the cylinder bore. This is a simple job; all you have to do, is to file a bevel about 3/32 in. deep, in the edge of the bore, at each end of the cylinder, extending the full width of the three holes. This is shown in the longitudinal section, and also in the end view showing the passageways. The great thing to avoid, when filing,



Slide-valve, nut and spindle

is hitting the bore with the tip of the file ; and to make certain of this, a good wheeze is to bend a bit of thin tin, brass, or anything else handy, into a half circle, and slip it into the bore, opposite the passageways. Then, if you are a wee bit too vigorous on the forward stroke of the file, the point of it will hit the shield, and the bore won't be damaged.

Now for the covers. Do the front covers first. They should have a chucking-piece cast on the outside. Grip this in the three-jaw, and set the cover to run as truly as possible ; a gentle tap with a small hammer will do the needful, as bronze or gunmetal castings are quite ductile. Face off the rough skin with a round-nose tool set crosswise in the rest ; then put a knife tool in. The cutting edge of this shouldn't be exactly at right angles to the lathe centres ; because if it is, on the average small lathe, it will chatter like Old Nicko if the full length of the cutting edge makes contact with the cover. Slant it slightly towards the lathe headstock, so that only the point and a little of the edge, will cut. Set your slide gauge or calipers to a little over $\frac{11}{16}$ in. opening, and very carefully turn a full $\frac{1}{16}$ in. length of the cover, until the gauge jaws or caliper tips will just slide over. If you take off about $\frac{1}{16}$ in. at a " bite," and run the lathe at medium speed only, there won't be any chattering, neither will the tool try to dig in. When the little projection has been turned to a diameter that the calipers or gauge will slide over, very carefully turn off a shade more, until it will enter the cylinder bore without the least bit of shake. This projection is known as the register, because it registers the cover truly with the cylinder bore. Now watch your step again : on the last cut, when you have got the register to dead size, feed the tool in a weeny bit, as so to make a slight undercut, or groove, at the end of the register ; then draw it back, which will take a skim off the face of the flange part, which makes contact with the cylinder casting, and leave it perfectly true. The edge of the cover can then be turned to $1\frac{3}{16}$ in. diameter, and the operations repeated on No. 2. Face 1/64 in. or so off each register, before removing from chuck.

The way I hold the covers to face off the outsides, is by gripping them in a home-made step chuck held in the three-jaw. Old-time craftsmen used wood chucks for jobs like these, and young Curly followed their example on his first tiny lathe. A piece of hardwood was either gripped in the chuck, or screwed to the faceplate by woodscrews through the back ; then a recess was turned in the face of the wood, just big enough to allow the cover to be pressed in tightly. The outside was then faced off with a round-nose tool. This method is still quite good, and beginners who haven't a bit of metal to make the step chuck, can use it with advantage. A piece of metal $1\frac{1}{2}$ in. diameter and about $\frac{1}{2}$ in. thick, is needed ; chuck this in the three-jaw, and turn down about $\frac{3}{8}$ in. length to a little over 1 in. diameter. Exact measurement doesn't matter. Reverse in chuck ; face, centre, drill a pilot hole right through, and open it out to about $\frac{3}{4}$ in. diameter. If you haven't a drill that size, use the biggest you have, and finish with a boring-tool, same as boring cylinders. Next, with a knife-tool set crosswise in the rest, and starting from the edge of the hole, form a recess 3/32 in. deep in the face ; this should be an exact fit for the cover. Make a centre-dot in the edge, or face, opposite No. 1 jaw of the chuck ; take out the step chuck, as the piece of metal has now become, and make a hacksaw cut through one side of it, as shown in the sketch. Replace in three-jaw, with the dot opposite No. 1 jaw ; put the cover in the recess, tighten the chuck jaws, and the cover will be gripped firmly, and dead true, whilst you face off the outside. Saw off the chucking-piece first.

How to Machine the Back Covers

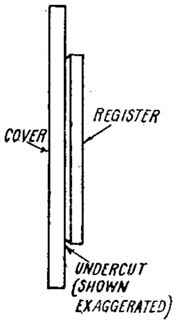
The back covers are a little more tricky, as they carry the gland bosses, and the guide bars. The first part of the operation is to turn the registers, and the diameter, exactly as for the front covers ; it is important that the registers fit the bores exactly, without a vestige of shake. Before removing from chuck, centre each cover carefully with a size E centre-drill in the tailstock chuck, and drill about $\frac{1}{2}$ in. depth with No. 21 drill. This is the clearing size for the 5/32-in. piston-rod. Now put your step chuck in the three-jaw, and set a cover in it, with the gland boss outwards. Saw off the chucking-piece, and face off the boss with a round-nose tool to the dimensions shown in the illustration last week. The metal of the cover below the boss cannot, of course, be faced off in the lathe, so it will have to be hand-filed when the machining is finished. There *is* a way of getting a machined surface over the whole of the cover, but this involves fitting a separate gland boss, and we needn't both about such refinements on a job like little " Tich."

Where many beginners fall out of the cart, in a manner of speaking, is in getting the gland concentric, or dead true, with the stuffing-box ; yet it is *so easy* when you know how. If a tyro opens out the piston-rod hole with an ordinary drill, in 99 cases out of 100 the bigger drill won't line up properly with the smaller hole. The error is usually exaggerated when tapping. Then, when he makes the gland, there is a chance that the piston-rod hole in that won't be dead central either ; so we then have the combination of an eccentric gland in an eccentric stuffing-box. The holes in gland and stuffing-box only line up in one position of the gland ; a fraction of a turn either way, throws them out of line, and the piston-rod promptly jams or binds in both.

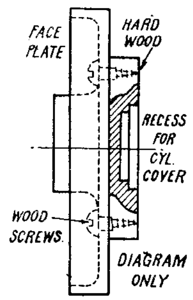
All you need do, to prevent this untoward happening, is to open out the piston-rod hole with a pin-drill. I have already explained how these are made ; so make one a weeny shade under 9/32 in. diameter, using a piece of 5/32-in. round silver-steel for a pilot-pin. After facing off the boss, put this pin-drill in the tailstock chuck, and open out the hole in the boss with it, to a depth of $\frac{5}{16}$ in. Then tap it $\frac{5}{16}$ in. by 32, using a tap guided by the tailstock chuck, in exactly the same way that I described for tapping the ends of the valvebox on the pump casting. Go very steadily to work, as it is essential that the threads be clean and true. The unturned part of the cover can then be

cleaned up with a file; to hold the cover, screw the end of a piece of $\frac{5}{16}$-in. brass rod $\frac{5}{16}$ in. by 32, screw it into the tapped stuffing-box, and you have a nobby handle.

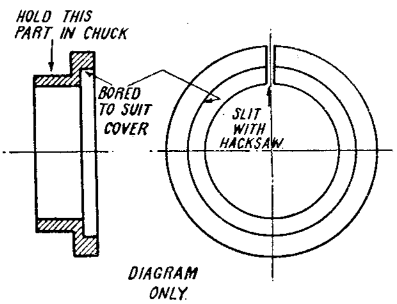
The next job is to drill and tap the holes for the guide-bars; and to save needless repetition, please turn back to the description of the cylinders of the "Wee Dot like Doris." Make a plug as described, to fit in the stuffing-box, and show the true centre of same, and scribe a line across this centre, down the middle of the gland boss. At exactly $\frac{7}{16}$ in. above the centre, make a centre-pop on the line; drill it about $\frac{1}{4}$ in. deep with No. 40 drill, and tap $\frac{1}{8}$ in. or 5-B.A. Use the drilling machine or lathe, because if the hole isn't dead square with the face of the boss, the guide-bar won't line up with the piston-rod, and you will be in a nice old mess when assembling the crossheads.



Front cylinder cover



Old-time way of chucking cylinder covers



Home-made step chuck

How To Drill the Cover for Screws

There isn't the slightest need to mark out all the screwholes separately on each cover; life's too short! Use a simple jig. Get a washer, or a brass disc, the size of the cylinder cover, or a weeny bit larger. Chuck this truly in the three-jaw, and drill and bore the centre hole until it is the same size as the cylinder bore, so that it will fit on the register of each cover. Set out the location of the screwholes on this, as shown in the end view of the cylinder illustrated last week; make a centre-pop at each location, and drill No. 40. Put this drilled washer over the register of each cylinder, and hold it in place with a toolmaker's cramp; then run the drill through all the holes, carrying on clean through the cover. Warning: the back covers have to be attached to the cylinders, so that the hole for the guide bar in the gland boss is exactly above the piston-rod hole. By the same token, as Pat would say, the screwholes have to be drilled to miss the passageways. Therefore, when attaching the jig to the back covers, make certain that the holes in it correspond to the holes shown in the end view of the assembled cylinder; also, don't forget that one cylinder (the one shown) is right hand, and the other left hand, and the offset of the holes in the left-hand cylinder, will incline the opposite way.

As the machining of the two cylinder castings was carried out in the same way, they should be exactly alike, and up to this stage there is nothing to distinguish right from left, or back from front; so now mark one right, and one left. I use a set of letter punches and figures for marking. These may be obtained in all sizes from 1/32-in. characters upwards. The $\frac{1}{16}$ in. size is about the best for our job, with normal eyesight; they don't disfigure the parts, and the letters or figures are easily readable. You could also use one dot for right, and two dots for left, putting the dots at the front end. Then proceed to drill and tap the holes for the front cover screws. Put a cover on the front end, with the blank space in between two screwholes covering the bevel at the end of the passageways. Hold it temporarily in place with a toolmaker's cramp; then run the No. 40 drill through all the holes in the cover, and make countersinks on the cylinder flange. Remove cover, drill out all the countersinks with No. 48 drill, and tap 3/32 in. or 7-B.A. This job should also be done on the drilling machine or lathe, so that the screws go in nice and square. If they go in on the slant—what the kiddies would call lopsided or cockeyed—one side of the head touches the cover before the other. You go to tighten it down, and—click! Off comes its noddle!

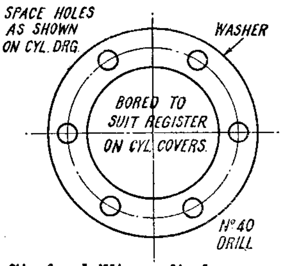
To set the back covers truly, put one in place with the guide-bar hole as nearly direct above the piston-rod centre, as you can judge by eye. Leave the centre plug in the stuffing-box. Hold the cover to the cylinder with a cramp. Lay the cylinder, bolting face down, on the lathe bed or drilling machine table. Set the needle of your scribing block to the centre of the plug; then adjust the cover until the centre of the hole for the guide-bar is at the same height, and you can run the scriber needle along, with the point touching the marked line on the gland boss, for its full length. Tighten the clamp, and proceed to locate, drill and tap the screw-holes, as described for the front covers.

It is quite possible that the flanges of the cylinder castings will now project beyond the edges of the covers; mine usually do, as my own patterns allow for plenty of metal. If so, run the point of an ordinary scriber around the edges of the covers, which can be temporarily fixed by two screws in each, for this purpose. Then remove covers, and file the flanges until the lines just disappear; this will permit a thin sheet of lagging to be put around each cylinder between the covers, and

flush with the edges of them Don't forget to mark which covers belong to right- and left-hand cylinders.

How to Turn and Fit Pistons

The success, or otherwise, of a locomotive, frequently depends on the fit of the pistons in the cylinders. I have often said, and emphasise again for beginners' benefit, that pistons should be perfectly steamtight, yet not mechanically tight. The old school of thought, considered this to be impossible, and got up to all sorts of weird and wonderful antics, to squeeze the packing into close contact with the cylinder bores, irrespective of how much internal friction was caused. My own engines never suffer from blowing pistons, and they work with such little friction that quite a moderate push will send the engine running down the line; whilst the distance they will coast with steam shut off, is amazing. The secret of success, to is have the piston-rod dead in the middle of the piston, so that when the cover is on, and the piston-rod projecting through the gland, you can twirl the rod between thumb and finger, without feeling a tight place anywhere in the bore; yet the piston itself is an exact fit in the bore. A precision job, says the beginner; however can I manage it on my not-so-precision lathe? Easy enough, as you will see.



Jig for drilling cylinder covers

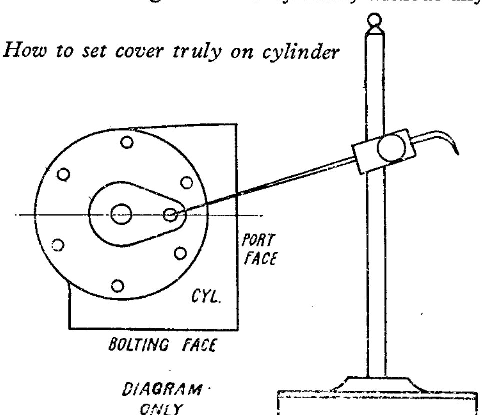
First of all, make the rods. These can be rustless steel or phosphor-bronze, cut to the length shown in last week's illustration. Either ground or drawn rod of 5/32 in. diameter, will do fine. Chuck each piece in the three-jaw, and put a bare 1/4-in. length of 5/32-in. by 40 thread on one end, with the die in the tailstock holder.

The pistons can be made from 3/4-in. round bronze or gunmetal rod, or from castings or cast stick bronze. Chuck the rod or stick in the three-jaw; turn down about 1 1/8 in. length to 1/64 in. over finished diameter, as measured by slide-gauge or calipers. Face the end, centre, and drill down 1/2 in. depth with No. 30 drill. At 1/8 in. from the end, form a groove 3/16 in. wide, and 3/16 in. deep, with a parting tool; then part off at a full 7/16 in. from the end. Repeat operation for piston No. 2. Chuck each piston blank in the three-jaw, parted-off side outwards, and take a truing-up skim off it, as some parting-tools leave a scored surface; then open out the centre hole for half its depth, with a No. 23 drill. Tap the rest of the hole 5/32 in. by 40. Put one of the piston-rods in the tailstock chuck, threaded end outwards, and tighten well up, so that the smooth rod cannot slip. Run the tailstock up to the head end, and enter the screwed end of the piston-rod into the hole in the piston. Carefully pull the belt by hand, and the screw will draw a part of the plain rod into the enlarged end of the hole in the piston. This way of fitting, part by screw, and part plain, is the way all chucks of precision lathes are fitted to the mandrel noses, and is the finest way I know of ensuring that the piston is quite true on the rod. Keep going until the rod has entered the piston for its full width.

Finally, the piston has to be fitted to the cylinder. I don't suppose that many beginners have a precision lathe fitted with collet chucks, but if there *are* any such lucky persons, all they have to do, is to grip the piston-rod in a 5/32-in. collet, and turn the piston to a sliding fit in the cylinder. Users of ordinary lathes with only a three-jaw chuck of doubtful veracity, can, however, make quite an accurate job by using a split bush. Chuck a piece of rod (brass will do quite well) in the three-jaw, any small scrap end will do, a convenient size being 3/8 in. diameter and about 1/2 in. long. Face the end, centre, and drill through with No. 24 drill. Make a D-bit from a piece of the same sized steel, as the diameter of the piston-rods, and put this through the bit of brass, by aid of the tailstock chuck. Be careful when starting it at the entrance of the hole, and it will bore a hole dead true with the centre-line of the lathe mandrel, even if the chuck is out of truth. Now make a centre-pop opposite No. 1 jaw. Remove bush, split it lengthwise with a hacksaw from side to centre hole; rechuck, and run the D-bit through again, to remove any burring. If you put the piston-rod in the hole, and tighten the chuck jaws on the bush, both rod and piston should run truly.

Now, with very fine cuts, little more than mere scrapes, and a keen tool, like a pointed one with a rounded-off end (says Pat) turn down the two flanges or "lands" of the piston, until they are an exact sliding fit in the cylinder, without any

How to set cover truly on cylinder



shake. Use the cylinder itself, for a gauge. If your cross-slide has a micrometer collar, turn the piston to a very tight fit first, then advance the cross-slide a bare half-a-division of the collar. That will enable you to finish-turn the piston to a size that will be perfectly steamtight without relying on the packing, when the cylinder is at working temperature, and the oil supply is working properly. Take great care over fitting your pistons; it doesn't need much of a blow-by to waste more steam than the little "Tich" boiler can generate. Next stage, steamchests and valves.

PRACTICAL LETTERS

Temperatures

DEAR SIR,—I would like to correct two errors in Dr. Fletcher's recent letter on Feed Pump Design (November 17th, 1949).

Normal temperature and pressure (N.T.P.), the conditions under which one gram-molecule of any gas or vapour has a volume of 22.4 litres, as defined in metric units, correspond to 0 deg. C. and 760 mm. of mercury.

Absolute zero is a temperature of —273 deg. C. of 0 deg. C. absolute, i.e., 0 deg. Kelvin. In English units, this temperature is —460 deg. F. (0 deg. Rankine).

Yours faithfully,
Paisley. ROBERT G. GARDNER, B.Sc.

Why Not a Steam Engine ?—An Old Engine

DEAR SIR,—I think I can identify the engine, described by your contributor B.C.J., as a product of Messrs. Lucas & Davies, a firm well known to an older generation of model engineers. These engines were produced in sizes up to 2 in. × 4 in., and as Lucas & Davies sold castings as well as engines, one may suppose that B.C.J.'s engine was amateur-built. The drawings that I have were published in Hasluck's book on model engineering (dated 1888) so it looks as if B.C.J. has got hold of a real old-timer. The feed pump should be horizontal, attached to the front of the trunk guide.

Yours faithfully,
Swanage. H. E. RENDALL.

The International Regatta

DEAR SIR,—It is a somewhat strange part of human nature that a remedy is rarely sought or applied *before* a difficult situation actually arises, although the fact that the problem is *bound* to occur sooner or later is plain to see.

Surely such is the case in the present disturbance over Mr. Stone's "International" activities, for at the risk of being accused of saying "I told you so" I cannot help but refer readers to a letter on this very subject published in these columns some months ago (February 3rd, 1949) and which I wrote with the express purpose of trying to avoid the present situation.

Now that the "deed is done," however, it is fairly obvious that the remarks made then were not entirely without foundation!

I will not repeat my own views on the matter, for I feel they are already known, but while agreeing entirely with Messrs. Mitchell and Clark—whose letters I read with considerable relish—that a battle between the "home-made" fraternity is the "real thing," I cannot help but wonder if it would be unwise to scorn any assistance that a manufacturer could give, in the case of international events; for these are if the title is taken at its true meaning, contests between *nations*, and not necessarily between individuals.

It almost goes without saying, that said manufacturers should be restricted to assisting their own country *only*!

I believe it is almost impossible for an individual amateur working in his spare time and within the scope of his pocket money to compete successfully with top-notch firms who devote the whole of their time and resources to producing better and better engines, and the only solution that I can suggest is in the formation of a separate class; indeed, this is already in being in the M.P.B.A. for regattas held under their jurisdiction.

Unfortunately, the same cannot yet be said for the Model Car Association, and in the 10-c.c. class at the time of writing we have the unsatisfactory situation in which most open events, and even so-called British Championships can only be won by persons with either cash, contacts, or both, in as great a travesty of genuine sport as can be imagined, for the present-day "top line" cars and engines are obtainable only by a great minority.

It may give lovers of fair play some satisfaction to know that thanks largely to the initiative of the hon. secretary of the M.C.A., Mr. G. E. Jackson, the team which recently visited Sweden was comprised *entirely* of British-made cars *and* engines, and though we certainly did not carry all before us, nor even expect to, I feel that at least we pointed the way to a *genuine* International.

Yours faithfully,
Stoke-on-Trent. F. G. BUCK.

International Racing

DEAR SIR,—In reference to the recent letter by Mr. Stone on his continental experiences.

Mr. Stone is quite welcome to his successes, hollow and meaningless though they be, but his inferences about hospitality, the complaints of the Victoria Park lake, and the remark about free-running craft, each call for a reply.

It has not yet been the good fortune of this country to have a strong body of foreign competitors at our own international, except for Mons. Suzor, and in years past a very few of his compatriots, but Mr. Stone can rest assured that the M.P.B.A. would rise to the occasion should it arise, though perhaps in a more homely manner than that shown to himself abroad.

As for Victoria Park lake, if Mr. Stone instead of seeking excuses for his failures there helped to keep the course clear of floating rubbish while awaiting his turn to run (a point some others could bear in mind), no doubt he would then be able to show off the true paces of his boat, if he got going.

The remark about free-running craft shows a lack of sportsmanship and understanding, fortunately rare amongst power boating folk, but is, perhaps, understandable, as were Mr. Stone more of a true amateur sportsman perhaps he would not seek his boating honours in the way he does.

As he himself states, he did run the world's worst regatta; with such views, could he have done otherwise?

Yours faithfully,
Catford. F. H. JEPSON.